THURSDAY, JULY 8, 1915.

EMMA DARWIN AND HER CIRCLE.

Emma Darwin: A Century of Family Letters, 1792–1896. Edited by her daughter Henrietta Litchfield. Vol. i., pp. xxxi+289. Vol. ii., pp. xxv+326. (London: John Murray, 1915.) Price 21*s.* net. Two vols.

CURIOSITY as to the intimate life of those who have become distinguished is at any rate human. It may be that in some cases it would be better if the veil were not withdrawn. But there is a better reason by which such curiosity is justified. We want to know what were the conditions under which great personalities have been produced. These remarkable volumes will charm by their literary merit. But here they invite considerations of a more scientific kind.

They give the history of three notable families which intermarried until they formed a sort of clan. The Allens were landed gentry of north of Ireland origin but settled in Wales; the Wedgwoods in Staffordshire and the Darwins in Lincolnshire were yeomen who rose in social rank, itself a note of racial ability. The relationships would be perplexing but for the pedigrees. All three strains were united when Charles Darwin married his cousin Emma Wedgwood.

The men had plenty of fibre, sometimes a little too fibrous, the women no less charm and vivacity. John Allen had nine daughters; the eldest married the second Josiah Wedgwood; one Sir James Mackintosh, whom Darwin thought an even better talker than either Carlyle, Macaulay, or Huxley, but whose misfortune was never to have red tape to tie up his bills; another was grandmother to Georgiana, Lady Salisbury; and still another was the wife of Sismondi, the historian. All families were well-to-do and "middle-class." But what a class it was; there was nothing like it at the time except the aristocracy at Geneva, with whom it was in touch through Sismondi and Madame de Staël. When Darwin married, a friend wrote: "It is very like a marriage of Jane Austen's, can I say more?" He could not, for the entire atmosphere was that of Jane Austen, wholesome, vivacious, intelligent. One of the Allen daughters made a penetrating remark *à propos* of an incident at Sydney Smith's: "In the gay world they commit more offences against the decencies of society than in the middle classes."

But though well-to-do the middle class of the early nineteenth century was simple and unaffected in its mode of life and content with intellectual pleasures. With leisure and freedom from anxiety it could turn to science and recruited the Royal Society. This swept that body into the social life of the day, which is now inevitably ebbing away from it. Darwin speculates in a letter to a son as to "what makes a man a discoverer of undiscovered things," and remarks that "many men who are very clever—much cleverer than the discoverers—never originate anything." He conjectures that "the art consists in habitually searching for the causes and meaning of everything that occurs." Perhaps the explanation lies in the difference between the inductive and deductive temperament. Hereditary aptitude must also count for something. The clan was clever enough but never failed to throw up originality. Tom Wedgwood was "the first discoverer of photography," Hensleigh was a mathematician and philologist, John with Sir Joseph Banks founded the Horticultural Society at Hatchard's shop, Sir Henry Holland and the Galtons were cousins. The amateur has been the glory of English science; there is now little place for him. The ground to be traversed before the fighting line is reached is too vast, and each worker must be content to "nibble" at his own little section with small knowledge of what the rest are doing. And so, rather unkindly, Prof. Armstrong describes the Royal Society as a "rabble." Science must now be content to be professional, if not professorial. In the last century it was not so. Leading men of science were in touch with one another and the larger life and influenced it. It seems strange to read that in 1842 at the Athenæum "they have *soirées* every Monday evening, and as all the literary and scientific men in London are in the club, they must be very pleasant."

In the second volume Mrs. Litchfield has given a picture of her mother which is a worthy complement to that her brother has given us of their father. Maria Edgeworth describes her "radiantly cheerful countenance, even now, debarred from all London gaieties and all gaiety but that of her own mind by close attendance on her sick husband." And the resources of that mind fill one with admiration. Some things are told almost too sacred for publication, yet one is glad to have known them. Two letters which she wrote to her husband on religion could not be surpassed for courage and affection. Darwin wrote on the last, "God bless you." Her literary judgment was admirably sound. Of course she knew Jane Austen by heart and could give off-hand the christian name of Mr. Woodhouse, asked in an examination paper, the point being that it can be inferred though never stated.

All sorts of celebrities flash through the pages,

and there are plenty of thumb-nail sketches of them. It is interesting to know that Robert Brown, whom Humboldt calls "the glory of Great Britain," was shy and a dead weight at a dinner party, as it explains why he was thought morose. This was not Humboldt's fault, as at a breakfast at Murchison's he "talked without any sort of stop for three hours." Carlyle "is very pleasant to talk to, he is so very natural"; he said Cardinal Newman "has no occiput," and Woolner seems to have found it was more than a metaphor. It is difficult to resist quotation. But the opinion of Sir Francis Galton cannot be omitted, "that truth or falsehood in a nation is merely a question of geography, and that the nations who have not got the article do pretty well without it."

COLLOID CHEMISTRY.

The Chemistry of Colloids and some Technical Applications. By Dr. W. W. Taylor. Pp. viii+328. (London: Edward Arnold, 1915.) Price 7*s.* 6*d.* net.

THIS work can claim to meet a long-felt want with more justice than the majority of publications heralded by that familiar phrase. Until its appearance it has been necessary to refer students to German text-books, many of which are extremely difficult reading for even fair scholars of that language, while most of them devote considerable space to the discussion of theories of the soundness of which the beginner cannot be, and should not be tempted to imagine himself, a judge.

It is one of the merits of the present text-book that by far its larger portion consists of a lucid and concise account of observed facts, the description of which precedes the discussion of theories advanced to explain them everywhere but in the section dealing with adsorption, where the reversal of this order is undoubtedly the only pedagogically sound procedure. The text is divided into four parts: general properties of colloids; methods of preparation; adsorption and applications of colloid chemistry. The subjects indicated by these headings are treated clearly and adequately, the instructions for experimental work being particularly satisfactory—with the exception, perhaps, of ultra-microscopy. This is a point which always presents difficulty, as a knowledge of the principles of high-power microscopy must be presumed which is by no means general. As regards theory, the reviewer has been particularly struck with the very lucid summary of von Weimarn's theory of dispersoid formation, which gives the student all that is essential, while saving him the labour of wrestling with the extraordinarily difficult style of the original.

The chapters on adsorption generally follow Freundlich, but include some recent and important work on the behaviour of sols in contact with other liquid phases. A very necessary warning against identifying phenomena only superficially similar with adsorption, and against using the latter as a facile explanation of obscure processes, is sounded repeatedly. In the concluding section the application of colloidal chemistry to the explanation of various phenomena is illustrated by a number of examples selected at random and including the unavoidable dyeing and tanning. Here, also, the author is careful not to countenance any extravagant claims on behalf of the science, and the student will be left under the correct and stimulating impression that colloidal chemistry can show—in the words of the famous epitaph—"great achievement but still greater promise."

The book is well printed and adequately illustrated, and may be unreservedly recommended to all students desirous of a sound knowledge of what is probably the most widely important, and certainly the most fascinating, branch of physical chemistry.

GEOGRAPHY AS A SCIENCE.

The Teaching of Geography. By B. C. Wallis. Pp. viii+221. (Cambridge: At the University Press, 1915.) Price 3*s.* 6*d.* net.

PERHAPS no school subject, in recent years, has been so much discussed as that of geography. The old meaningless lists of names of places, "famous for" all kinds of curious, as well as important things, has been ruthlessly consigned to the scrap heap. Exactly what is to take its place no one has yet determined, and each expert goes his own way and proclaims his own gospel. Geography—economical, physical, regional, historical, practical—has annexed so many other domains of learning, that the specialists differ within very wide limits, and the non-specialist teachers are overwhelmed by conflicting claims, arguments, and interests.

This book, by Mr. B. C. Wallis, covers most of the questions that interest the practical teacher, and on each and all of them he has much to say that is valuable. He is a teacher himself, that is, a teacher of children; some of the people who theorise upon the subject are only teachers of adults.

Mr. Wallis would have us divide our school schemes of work into three sections—descriptive in the early stages; transitional for the inter-

mediate stages; systematic and argumentative in the later stages. The descriptive stage includes story-telling, the awakening of the child's imagination and interest, and the introduction of simple map and out-of-door work. In the transition stage, the pupil is chiefly concerned with the investigation of *geographical principles* rather than with the acquisition of geographical facts. In the final stage, the pupil has to collect his own data, to construct his own maps and diagrams, and to reason out his own conclusions, that is, he has to learn the methods and principles of *geographical argument*. Most teachers will agree with these divisions, and be prepared to follow Mr. Wallis in his treatment of the first and second stages; the ideas and methods of the third stage are more debatable, but, from the author's point of view, they are well stated and reasoned.

It is difficult, in a short space, to mention even a fraction of the valuable things the book contains. There are practical exercises for in and out of doors; plans and suggestions for the ideal geography-room and for apparatus; arguments on the relation between geography and history and other subjects, with sensible ideas on correlation; and there are even a few lessons for examiners on how to set examination questions.

Everywhere full details are given in a style attractive, lucid, and often of considerable literary merit. In many places there is geographical information of great value, information such as a teacher cannot always find in the text-books at his disposal.

Full approval may be given to the recommendations to teachers of geography to avoid straying into attractive historical or geological byways, interesting as they may be, for they are not geography, and there is plenty of work to be done without going out of the proper field. It is wise, also, to insist that the geography teacher is not to wait for the science master to explain the working of a barometer before the results of reading the barometer are utilised, nor to waste his own precious time in explaining what falls within the province of another. Sometimes the academic treatment of a subject has to give way to a common-sense one, but it is not every author who writes a book who is willing to state this truth.

We commend the book to all teachers of geography, because it is so eminently sensible, practical, and stimulating. They need not adopt all the conclusions of Mr. Wallis, but they will find it difficult to disprove their truth, or to resist their attractiveness.

MUSICAL FORM AND DEVELOPMENT.

The Musical Faculty: Its Origins and Processes. By W. Wallace. Pp. vi+228. (London: Macmillan and Co., Ltd., 1914.) Price 5*s.* net.

THE systematic and scientific study of the psychological processes involved in the creation and production of music is, from the nature of the case, exceedingly difficult, and the author is fully justified in claiming that there is room for further literature on the subject. How far he has been successful in dealing with these problems in the present book is open to some doubt.

Speaking generally, the first four chapters deal mainly with the development of music pure and simple, the remainder with musicians and their characteristics. Now in treating of individuals, there is no lack of statistical and historical evidence on which to base conclusions. Whether the subject-matter be the existence of musical prodigies, the part played by heredity, the influence on health, both mental and physical, of great musical genius, or such functional characters as mental audition, tonal memory, sense of tempo, power of detecting differences of tone quality, inhibition of sound perception, the data from which inferences may be drawn are of a fairly definite character, and, on the whole, Mr. Wallace's treatment may be regarded as satisfactory. But the present reviewer totally disagrees with what he says about music itself in the chapters entitled "A Readjustment of Values," "Historical Bearings," and "Individual Development."

Mr. Wallace may prefer modern French cacophonies to Haydn's and Mozart's delightful quartets and symphonies, but he surely cannot seriously wish us to believe that those early composers were lacking in originality or individuality simply because they could obtain what they wanted with the use of simple chords and melodies. Neither can we agree with the statement that "Music, as we understand it, has not yet established her eternal verities," and when he states that "it would be no feat for a composer to write another *Orfeo* to-day," we can only say we should like to see anyone try to do it!

Admittedly, both the character of musical form and the recognised standard of excellence are changing, and the changes are the result of a process of evolution similar to that which exists everywhere else. But evolution does not always represent a change to a higher standard of perfection. It sometimes stands for degeneration, and "a readjustment of values" may spell barbarism, as is evidenced in the use of poisonous

gases in war and the massacre of women and children. We would rather suggest that musical art possesses an element of *permanence* which is not to be found in the other arts. The collection of masterpieces which the present generation has inherited from the classical composers is so large that a modern composer, working on the same lines, would find it next to impossible to assert his influence. Consequently, musicians have had to seek fresh fields and pastures new by tearing up the "scraps of paper" which their predecessors regarded as binding.

OUR BOOKSHELF.

Surface Tension and Surface Energy and Their Influence on Chemical Phenomena. By Dr. R. S. Willows and E. Hatschek. Pp. viii + 80. (London: J. and A. Churchill, 1915.) Price 2*s.* 6*d.* net.

THE appearance of this book, following close on that of a similar work by Michaelis, is a welcome sign of the increasing interest now taken in this subject. The distribution of matter and energy at any interface, although of the first importance, has only come into prominence since the development of colloid chemistry.

The scope and character of the book may be indicated by a reference to the chief subjects discussed. They are:—the fundamental ideas of surface tension; intrinsic pressure; Gibbs's surface excess formula; recent experimental work on interfacial concentrations; electrical phenomena at interfaces, with special attention to the Lippmann electrometer and the dropping electrode; and, in conclusion, such matters as condensation on gas ions, effect of electrification on the vapour pressure of drops, and "waterfall electricity."

It is scarcely surprising that the authors have found it no easy task to co-ordinate these varied subjects; and to this difficulty is doubtless due a want of clearness in a few places. There is one notable omission; one would have expected to find the development of the surface excess equation, either as given by Gibbs himself, or by Thomson or Milner. Curiously, no mention is made of Milner's experimental work, the first attempt to test the formula.

In spite of these defects, the work must prove helpful to advanced students and research workers, biological and technical, who have a practical interest in adsorption and allied phenomena. There is a useful index, but it seems a pity that no references to original papers are given. W. W. T.

Fire Tests with Glass. "Red Books," Nos. 196 and 197. (London: British Fire Prevention Committee.) Price 2*s.* 6*d.* each.

THESE two small books embody the British Fire Prevention Committee's Report on Fire Tests made respectively with skylight openings and windows filled in with "wired glass" manufactured in our own country. The skylights were five in number, each 2 ft. square, and arranged horizontally in a single straight row. The glazing was subjected to fire for an hour, followed by water from a steam fire-engine applied at close range for two minutes on the fire side. No fire passed through the glazing, but more or less water found its way through three of the five. Details of the tests are given, with illustrations showing the effects of the fire. The three vertical windows were subjected to a precisely similar test with much the same results. In the case of two of the windows neither fire nor water passed through the glazing, but in the third, though no fire passed through, the application of water caused perforation and some water got through. The temperatures reached before the application of water were not less than 1500° F. (or 815·5° C.). The maximum size of the vertical glazing tested was four feet by one foot.

The results of the tests clearly indicate that British wired glazing, when suitably fixed, can effectually check the spread of fire in a manner comparable with fire-resisting partitions and doors of much greater thickness and weight. The subject is well worth the serious attention of those interested in the limitation of damage by fire, especially in cases where the admission of light is desirable. J. A. A.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Okapi.

IN my letter published in NATURE of May 27 (vol. xcv., p. 342) dealing mainly with the "Supposed Horn-Sheaths of an Okapi," I stated that "it is only when extremely young that the backward slope of the back is very noticeable." It is perhaps the only statement I have made regarding the okapi which was not based on my own observations, and it appears to be erroneous. The impression was derived from a photograph reproduced in M. Fraipont's "Monograph on the Okapi," of a very young one captured by natives and brought into one of the Uele stations. I have since seen a photograph of the same animal from another source which shows that there was very little backward slope. At maturity the height of the okapi at the shoulders is only 2 to 3 in. at the most more than that above the hindquarters. The following measurements taken from three animals lying as they fell, one by Mr. A. E. H. Reid, and two by myself, bring this out quite clearly:—

	Young male (No. 507)	Old female (No. 686)	Old male (Reid's) (No. 717)
	ft. in.	ft. in.	ft. in.
Nose to tip of tail (without hair) ...	6 1½	8 2	7 11
Tail (without hair)	0 14	0 14	0 14
Height at shoulder	4 4¼	5 1½	4 11½
Height above hind quarters	4 2	4 11½	4 9
Excess of height at the shoulders ...	0 2¼	0 2	0 2½

Mr. Reid has given me the following additional measurements for his specimen:—Girth of neck in front of shoulders 2 ft. 11½ in., and girth of chest behind shoulders 5 ft. 7 in.

The okapi has no "hump" at the withers, as might be supposed by the length of the spinous processes of the dorsal vertebræ and as represented in many mounted specimens. The back is as straight as that of any horse or antelope. The neck is deep at the base and tapers to comparatively small dimensions immediately behind the head without any curve. The body is rotund, and the limbs remarkably clean and sleek. The animal as I have seen it has distinctly graceful proportions, and does not give one the impression of being all angles as in the giraffe. When standing on the alert it holds the neck fairly high, slightly above the line of the back, with the head poised at an angle, and the ears well forward.

The animal is probably a surviving primitive form of a family closely allied to the ancestors of the giraffes, which, as the forest once covering all tropical and probably most of subtropical Africa gradually disappeared by the agency of man, have become modified, bulkier animals under the influence of sunlight and freedom in the open scrub country, where to browse on the young shoots of the thorny acacia trees, grown tall and table-topped owing to annually recurring grass fires, has necessitated the development of a longer neck.

The giraffe, now restricted to Africa, at one time, during the latter portion of the Tertiary period, I think, roamed far and wide over southern Europe and throughout a large extent of Asia. Similarly the okapi's area of distribution before the destruction of the forest was probably much wider than at present. There is, in fact, evidence that it inhabited the once forest-covered regions of the Upper Nile Valley. It was pointed out in 1902 that among the twelfth-dynasty paintings from Beni-Hasan, Egypt, there exists a picture, long known to archæologists, which portrays a creature termed "Sche," said to have a resemblance to the present-day okapi, except that the upper lip is somewhat protruded and proboscis-like, and there are no zebra-like markings, the body and limbs being of a uniformly reddish colour. It is possible that this picture represents a form of the okapi known to the ancient Egyptians. C. CHRISTY.

July 5.

Testing Respirators.

THE chief difficulty in the determination of the relative efficiency of these safeguards which are so freely offered to the public, and also utilised for the purposes of war, is the want of a standard method of testing the same.

As the result of a few preliminary experiments, I would suggest in the testing of different fabrics impregnated with chemical substances that the conditions of working must be standardised, and the following conditions met. A suitable container for the mixture of air and the poisonous gas is required, and this must lead directly to the surface of the fabric which is exposed to the action of the mixed gases as they pass through its substance.

The rate of flow of the gas through the cloth must slightly exceed that of the inflow of air under actual breathing conditions, and this must be standardised. The reduction in the amount of the added gas is observed by actual analysis, and the test only made after the air has been passing for a stated period, which must not be less than five minutes. The composition of the air being tested must correspond with that likely to be met with in practice. In the case of chlorine the reduction in the amount present in the air passing the treated screen can be easily observed by actual estimation. As so much depends upon the amount of moisture present on the screen, this should be also standardised. It may be contained in the gas as it passes the screen, which must be of constant area.

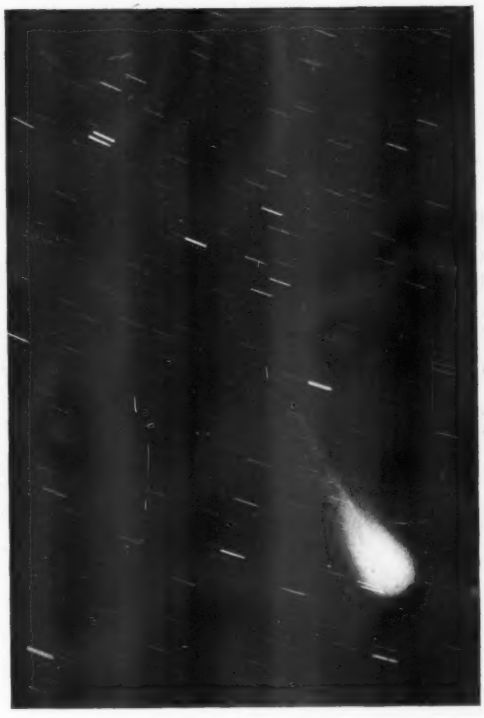
It is only possible by such means to study the effect of varying moisture on the rate of absorption, etc., and to set up standard conditions which will enable comparative results to be obtained.

I hope soon to be able to suggest what these standard conditions should be, and the best type of apparatus necessary to carry out comparative experiments. W. P. DREAPER.

London, E.C., July 5.

Photograph of Mellish's Comet.

I ENCLOSE herewith a contact print from a negative of comet Mellish obtained with the Franklin Adams star camera of the Union Observatory on June 6, 1915, with an exposure of ninety minutes. The position of



Comet Mellish, June 6, 1915. Exposure, 90m.

the comet was then R.A. 22h. 35m., declination 70° 18′ south.

The proximity of the comet to the pole is well shown, even over the small region of the photograph, by the change in the direction of the star trails.

H. E. WOOD
(Chief Assistant).

Union Observatory, Johannesburg, June 10.

Bird Migration.

A SMALL item which may be of interest to those watching bird migration was noted on a recent voyage to America.

On s.s. *St. Louis*, of the American Line, about 6.45 p.m. (ship time) on May 3 a swallow came on board, evidently very tired, white breast feathers rather dirty, and, settling down, was caught by one of the passengers. It took some water but died during the night. There was no identification band on either leg.

The point of interest is that the ship was then about 49¾° N. lat. and 23¾° W. long., which would put her some 560 miles west of Cape Clear—about W. by S.—and some 680 miles N.W. from Cape Finisterre. The wind had been fairly steady from E.S.E. for the previous thirty hours, blowing 20–30 miles an hour.

The first swallows had been noticed at the place where I now am on Saturday, May 1, and no doubt the bird which reached the *St. Louis* had got separated from the general migration.

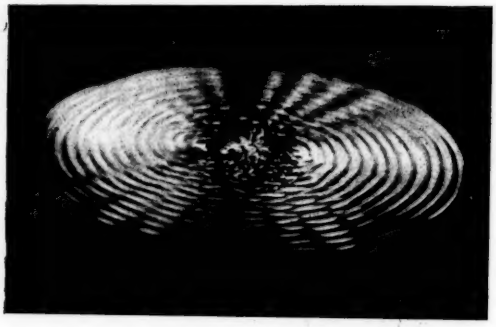
The bird seemed in fairly good condition, its brown throat and indigo head were sleek and glossy; the soiled breast feathers may have been due to the steamer's smoke as the bird came in from the lee side.

ED. WILDING.

Dunedin, Jordanstown, Co. Antrim, June 23.

Mercury Ripples showing Interference.

THE accompanying print of a photograph of mercury ripples showing interference, made in this laboratory, exhibits singularly well the circular waves from the two sources as well as the interference pattern produced. The two points of disturbance are maintained



by a forked pointer attached to the prong of a fork of frequency 50. With daylight illumination from a window, and a rotating sector to render the effect stroboscopic, a good natural picture of the surface is obtained.

S. G. STARLING.

Physical Laboratory, Municipal Technical Institute, West Ham, E.

Man's True Thermal Environment.

I FULLY agree with Mr. Grabham (NATURE, June 24, p. 451) as to the unsuitability of the constant-*temperature* (37° C.) psuchrainometer for many parts of the earth's surface. It is for this very reason, combined with the advantage of its much greater simplicity, that I am experimenting with the constant-*energy* form of instrument mentioned at the end of my former letter (NATURE, May 6, p. 260).

The effect of moisture can be brought into play with any type of psuchrainometer by providing its exposed surface with a water-wetted muslin cover, and no doubt in this condition the apparatus approximates more closely to the human body.

My interest in the matter, however, is physical rather than physiological. My immediate aim is to study the extent to which "atmospheric cooling" can be predicted from the readings of the existing meteorological instruments. It seems best, therefore, to begin with the simplest case of cooling, namely, that which is free from the thermal complications accompanying evaporation.

JAMES ROBERT MILNE.

Physical Laboratory, University of Edinburgh, July 1.

HIGH EXPLOSIVES.

MR. LLOYD GEORGE'S recent speech in the House of Commons, as Minister of Munitions, emphasised the very important part played by high explosives in the present war. It is essential at the outset to distinguish clearly between a propellent charge, which forces the projectile or shell through the bore of the gun, and the high explosive charge filling the shell itself and causing it to burst, through the intervention of a time or percussion fuse. Modern military propellants consist of gelatinised gun-cotton (nitro-cellulose), either alone or mixed with varying proportions of nitro-glycerine, pressed into any required shape. The finished explosive is of a colloidal, horny nature, and a piece of it held in the fingers, whilst burning, can be blown out quite easily. A charge lit in the enclosed space of the chamber of a gun can discharge a projectile with a velocity of about 1000 yards per second, developing in the chamber a pressure of, perhaps, twenty tons on the square inch. If the same quantity of the *ungelatinised* material were ignited in the gun-chamber it would detonate and blow the gun to pieces.

There is thus a wide difference between the effects produced by the burning of a propellant in the open, and in the chamber of the gun. In the latter case, before the projectile begins to move, the gases evolved produce pressure in the chamber, thus greatly accelerating the velocity of the explosive reaction.

The forces at work in the gun, however, are insignificant in comparison with those brought into play when a high explosive detonates. Even in the open, without any containing envelope other than a thin cylinder of paper, the writer has obtained with a high explosive a velocity of detonation of the explosion wave of some seven miles per second. When the high explosive is in an enclosed space, such as a shell, the velocity of the detonation wave is greatly accelerated, and in an almost infinitesimal period of time the explosive is converted into gases. The volume of gases produced varies according to the nature of the explosive, but, generally, for those used in shells, it may be taken that, at the temperature of explosion, the volume of gas evolved occupies from 15,000 to 20,000 times the volume of the original explosive. This is the reason for the enormous destructive and shattering effect of a high explosive.

The nitro-glycerine high explosives used in mining are unsuitable for shell filling, owing to the sensitiveness of nitro-glycerine to shock, which would cause premature detonation in the bore of the gun. The ammonium nitrate group of high explosives, also used in mining, which contain nitro-hydrocarbons, and in some instances aluminium, have been advantageously adapted for shells. Although the hygroscopic nature of ammonium nitrate is detrimental, this may be successfully overcome.

Abel, in 1865, first proposed the use in mines of compressed wet gun-cotton fired by means of a dry gun-cotton primer; this was later used for filling torpedoes, but it has the disadvantage of low charge density. Gun-cotton cannot be compressed to a greater density than 1·25. In other words, a torpedo head which would hold 125 lb. of compressed gun-cotton could hold from 160 to 180 lb. of the denser trinitrotoluene or picric acid, with a corresponding increase of destructive power.

Sprengel, in 1875, first showed that picric acid could be detonated, and in 1881, Turpin, in France, demonstrated the practical possibility of using it for filling shells. The idea was rapidly taken up by other countries.

The methods of manufacturing nitro-hydrocarbons suitable for shell filling are very similar to those in use for producing nitro-glycerine. A mixture of sulphuric acid and nitric acid is used, and large quantities, very frequently as much as a ton or even more, are made in one operation. To obtain the highest yields of pure products very great attention must be paid to the composition of the acids, to the efficiency of agitation, and to the temperature, which is regulated by internal heating or cooling coils.

Picric acid, discovered in 1771 by Woulfe, of London, when used for filling shells has a different name in each country. It is called Mélinite in France, Lyddite in England, Pertite in Italy, Shimose powder in Japan, Granatfüllung 88 in Germany, and Ecrasite in Austria. It is not always employed in the pure state, there being occasional addition of crésylite (trinitrocresol) or a salt of that substance, the object of which is to reduce the temperature of fusion. It is manufactured from phenol (carbolic acid, obtained from the distillation of coal-tar) by first dissolving in sulphuric acid and then treating the resulting phenol-sulphonic acid with nitric acid in excess. It forms yellow crystals with an intensely bitter taste. It has a specific gravity of 1·777 and melts at 122·5° C. Picric acid, if heated gradually, takes fire without explosion, giving rise to dense black smoke, but the application of a red-hot rod will cause it to detonate, as will also the explosion of a capsule of fulminate of mercury. Owing to the readiness with which it forms certain unstable metallic salts, the use of picric acid is not free from danger, and it is largely on this account that it is being rapidly replaced by the somewhat less energetic but much safer trinitrotoluene.

Trinol, trotyl, trilite, tritolo, or T.N.T., as trinitrotoluene is variously called, is made from toluene (obtained from coal-tar naphtha), and was first proposed for use in shells by Haüssermann, in 1891. The result of the first nitration of toluene is a mixture of mono-nitro-toluenes, which are then treated with a mixture of strong nitric acid and sulphuric acid, and raised to the third or trinitro degree of nitration in one stage. Trinitrotoluene, when pure, forms brownish-yellow crystals with a melting point of 81° C. It is very stable, not igniting below 300°, but when it explodes it does so with great violence. Its density when melted varies between 1·57 and 1·60. Neither picric acid nor trinitrotoluene can be detonated with certainty by fulminate of mercury, and a small quantity of an intermediate priming charge is employed. In the case of trinitrotoluene, the use of tetranitromethylaniline has been found suitable.

Tetranitraniline is a very powerful explosive, and has a higher density than either trinitrotoluene or picric acid.

The nitro-hydrocarbon high explosives used for the shell bursting are, in the molten state, poured into the cavity of the shell, in which they solidify, sufficient room being left for the priming charge and the detonating fuse. All the above nitro-compounds can only be obtained in a state of purity by re-crystallisation from various solvents.

Fulminate of mercury has been mentioned several times as a detonator, or initiator of explosion. Lead azide has been used, in conjunction with fulminate of mercury and tetranitromethylaniline, as a detonator for high explosives.

It will be noticed that the majority of the high explosives referred to are derived from coal-tar products, and it is therefore evident that Mr. Lloyd George's statement, "If there were a shortage in the coal supply for any reason, the consequences would be very calamitous," is one which must be taken very seriously.

GEORGE W. MACDONALD.

SCIENCE IN THE SERVICE OF THE STATE.

MODERN war is an affair of applied science—military, engineering, chemical, medical, and economic. Its successful prosecution requires more than an extremely high efficiency on the part of the officers in their professional work. Everything that chemical, physical, and engineering science can suggest must be pressed into service. The scientific men of the country have been keenly aware of this necessity from the beginning of the war, and many of them have individually done a great deal of important work for the Government and the various Services. The Royal Society has formed a War Committee, to which the Government has confided the solution of many pressing scientific problems arising out of the war. The public thanks of the country have been given to the Royal Society by Mr. Asquith. We note also with pleasure the issue, by the Council of the Chemical Society, of the letter (see p. 523) announcing that the Council has constituted itself a consultative body to consider, organise, and utilise all suggestions and inventions which may be communicated to it.

British chemists have now a clearing house for their ideas and discoveries, whilst the Government knows that it has the expert chemical advice of the country at its immediate disposal.

It is not going too far to say that practically without exception the services of the scientific laboratories of the universities, university colleges, and technical colleges have been offered to the Government. Very many—perhaps all—of these laboratories have done, and are doing, important public work relating to the war and the industries of the country. In this connection the Royal Society War Committee has done good work in organising special chemical work of an urgent character in the above-mentioned laboratories, and in obtaining from them competent young men to assist in the carrying on of the special chemical manufactures required at the present time.

The Institute of Chemistry has done excellent work in various directions. Particularly deserving of mention is the splendid public work done by the Glass Research Committee. The important scientific results obtained by this Committee have been made public (see NATURE, April 15, p. 192), and are therefore at the disposal of every manufacturer.

There is not a scientific society, scientific laboratory, or scientific man in the country that is not anxious and willing to help. Much good work has been already done. But there is undoubtedly a feeling that with better organisation and knowledge a vastly greater amount could be done. Speaking in the House of Lords on Friday last, Viscount Bryce urged that—

> Every possible effort should be made to utilise the services of scientific men. They all knew to how great an extent the German Government had turned the services of scientific men and establishments for investigation and research to account for military purposes. We possessed in this country a body of scientific men not, indeed, so numerous, but fully equal in competence and fully equal, he need hardly say, in earnestness and zeal to serve their country. He understood that there had been during the past months a certain amount of regret among scientific men that they had not heard from the Government how they could help. Any efforts which the Government made to give them a chance of coming in, and enabling them to turn their scientific knowledge, whether in chemistry or engineering, to the common purpose we all had at heart would, he was certain, be welcomed by them. The universities, in which there were so many scientific men, would gladly drop all their work in order to assist.

It is to be hoped that these wise words will be taken well to heart.

Science is standing Germany in good stead at present. It is known that the Badische Works, employing the process initiated by the scientific researches of Prof. Haber, had arranged for an enormous output of synthetic ammonia during the present year. About twelve years ago Prof. Ostwald, foreseeing (as he has himself publicly stated) a nitric acid famine in Germany during a period of war, investigated the conditions for the economical oxidation of ammonia to nitric acid. This process has been worked for several years at a factory near Vilvorde in Belgium. It is rumoured that Prof. Haber and the Badische Works have greatly improved the process, and that in conjunction with the synthetic ammonia process it now provides a large part of the nitric acid required by Germany for the manufacture of her explosives. *Ohne Phosphor kein Gedanke* said the materialist once upon a time. So might he now say, "No nitric acid, no war." Interesting notices have appeared from time to time in the *Chemiker Zeitung* relating to the activity of organised German science during the past twelve months. A new industry of zinc extraction has been developed, and it is reported that means have been found to replace the French bauxite required for the production of aluminium.

The shortage of copper has been discounted by the use of special alloys. It is also stated that processes have been developed for the manufacture of gasoline and lamp oil. Alcohol is being largely used in internal combustion engines.

We may feel sure that not only the universities and technical high schools, but also the splendid special laboratories of the *Kaiser Wilhelm Forschungsgesellschaft* are working at high pressure in the service of their State.

It is necessary—urgently necessary—that we should do as much, if not more. Let Britain call, British science is ready. It is straining at the leash. All that is wanted on the part of our leaders are imagination and sympathy. A little more of these, and the good that has been done can be magnified a thousandfold.

F. G. DONNAN.

MAMMALS OF EASTERN EQUATORIAL AFRICA.[1]

MR. ROOSEVELT'S second book dealing with his East African experiences will probably be more valued by naturalists than his first, though some portions of it may leave the naturalist cold where they excite to frenzy the man of primitive instincts, who still thinks

> Cet animal est très méchant,
> Quand on l'attaque il se défend.

To the mammalogist *Homo sapiens*, even in his Caucasic variety and English or Anglo-American race, is not more interesting than *Felis leo* or *Loxodon africanus*; and he is just as shocked and pained at the death agonies of the latter as of the sportsman who fails to kill dead at the first shot and is afterwards eaten up or trampled under foot. In fact, I for one, when I read in a newspaper some ten years ago that a German hunter who had frequently evaded my inquiries in East Africa as to big-game regulations and had at last—thank goodness!—been killed by a rhinoceros after having needlessly slain about seventy-three rhinoceroses for no purpose whatever but sheer love of killing, could not resist an expression of delight.

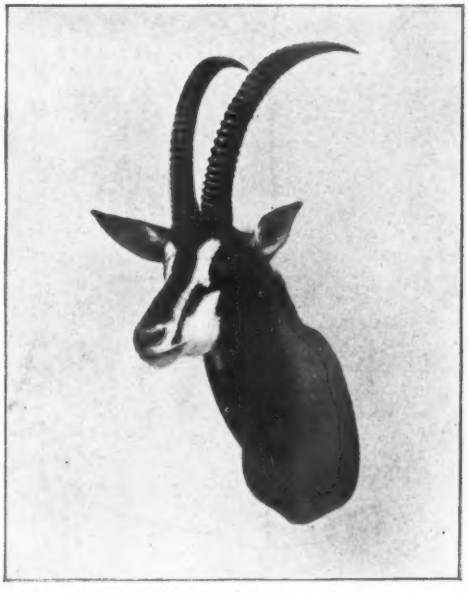
[1] "Life-Histories of African Game Animals." By Theodore Roosevelt and E. Heller. Vol. i., pp. xxviii+420. Vol. ii., pp. x+421-798. (London: John Murray, 1915.) Price 42s. net. Two vols.

However, the whole purport of Mr. Roosevelt's expedition, which for the most part has received unqualified approval on the part of serious-minded naturalists, was to enrich science with necessary specimens of beasts and birds for American and British museums, and above all to study the life habits of all interesting creatures in East Africa. There was no indiscriminate slaughter and good use was made of everything killed.

All persons who are worth anything in intellectual valuation have their special *tic*, some detail or some subject about which they worry unnecessarily, and in regard to which they would unhesitatingly send to the stake all who differed from them. The subject over which Mr. Roosevelt frets—I think unduly—is the coloration of mammals—perhaps also that of birds, reptiles, insects. He is angered by the extremes to which the theory of protective or assimilative coloration has been carried by some writers who have probably wrenched facts to suit far-fetched conclusions; and seemingly he would go to the opposite pole and, apart from the flagrant cases which no one denies—of bold advertisement coloration—would almost refuse to admit that there is any purpose in coloration at all.

Those who have seen much of beasts, birds, and insects in the tropics or in the wild regions of the temperate zone still adhere to the general theory that the coloration of living things has been gradually developed to serve a purpose useful in the main for the preservation and prosperity of the species. Yet the direction of this mental reflex on corporeal matter by no means seems all-wise from the point of view of the human critic. It does not—as Mr. Roosevelt points out—always lead to the betterment of the species or the well-being of the individual. Just as the *summum bonum* of daily fare on British steamers used to be governed by the steward's ideal of what he liked best in his humble home at Liverpool or Southampton, so the markings and outward aspect of this and that species of mammal, bird, and insect in some cases evince nothing of "divine" foreknowledge in the pattern, but seem rather to be the expression of some low, and possibly stupid, "intelligence": an ideal formed in the continuous mind of the species which passes on from individual to individual. Yet in most cases this ideal in colour and markings has unquestionably served a purpose, if a base one.

Wild creatures are far less conspicuous—unless they desire to advertise themselves—in their natural habitat than are the domestic animals of man's creation and protection. I remember once on the borders of Ovampoland, when I was comparatively new to Tropical Africa, gazing from a hillock over a vast swampy plain to see if there was any big game to be shot. My eye at once noted the great herds of native cattle—red, brown, black, black and white—distinguishable from their surroundings with the utmost ease. I decided there was no game in sight, but my native guides pointed excitedly in another direction. At first I could detach nothing from the shrubs, the ant-hills, the sedges, and the thorns, until at length, by the mere fact that they moved, I made out the forms of buffaloes and antelopes. The creatures the mind action of which was subordinated to ours, and which cared nothing for concealment, were at once visible to the eye, detached from their surroundings, and there, as elsewhere, an



Roosevelt Sable: adult male. From Shimba Hills, British East Africa. From "Life-Histories of African Game Animals."

easy prey to the Carnivora. But the wild fauna of the country was most difficult to detect by the eye; and other facts which have come to my notice have shown me that many of the great Herbivora actually escape notice by lions, leopards, chitas, hunting-dogs, and so forth, unless the wind turns against them and their presence is detected by a sense of smell. However, I do not wish to cross lances with Mr. Roosevelt, whose own theories in the main tally with the facts, but who always seems to me to get unnecessarily contentious about what he has in indirect ways himself to admit—that there *is* a purpose, even if it be at times a paltry one, running

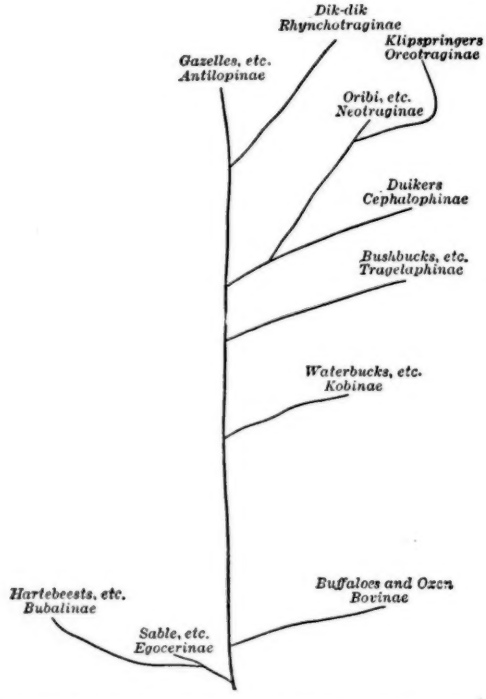


Diagram of the family Bovidæ showing relationships of the sub-families. From "Life-Histories of African Game Animals."

through the coloration of all the living creatures of this planet.

I, too, have my *tic*: and that is the classification, the phylogeny, of the Bovidæ. Probably it is Mr. Heller with whom I am about to fall out, and not Mr. Roosevelt. But one or other has introduced into the work under review theories and diagrams as to the descent and interrelationships of the antelopes and other bovids which are not only a perpetuation of nineteenth-century errors and misconceptions, but do not square with the facts of the comparative anatomy of the bovids, as set forth even as far back as the early 'eighties by the late Prof. A. H. Garrod; and in a very lucid and remarkable manner in our own day by Mr. R. I. Pocock, of the Zoological Society, as well as by the authorities of the British Museum (including the late Mr. Lydekker). Nor do they agree with what may be deduced from the most recent palæontological discoveries in Europe and North America.

In Mr. Roosevelt's book sufficient emphasis is not laid on the marked distinction existing between the tragelaphs and the antelopes. The mistakes in classification, which have travelled so far from Sclater and Thomas's otherwise admirable book of antelopes, have infected the ideas of either Mr. Roosevelt or Mr. Heller. These ideas include an unnatural isolation of the hartebeests and gnus, a misconception of the position of the oryx sub-family, and of the relations in general between the true antelopes with annulated horns, the goats, sheep, and capricorns (likewise with annulated horns where they retain primitive features), the oxen (with a trace of annulation on the horns of the most primitive types of Congo buffalo and anoa), and the tragelaphs (eland, bongo, kudu, bushbuck, and nilghai) without annulations.

This last sub-family has a few more primitive features in its skeleton and anatomy than the other divisions of the Bovidæ, though the ancestors of the oxen may have been not unlike the nilghai in appearance and anatomy, and in some way link the ancestral tragelaphs with the other groups. Notable among these "primitive" features are the ancient ungulate white spots and stripes, prevalent in some perissodactyls, in swine, tragulids, deer, tragelaphines, and Asiatic buffaloes; but absent from antelopes, sheep, and goats. Probably the most primitive of the existing tragelaphs is the four-horned antelope of India. Its existence there, and that of the nilghai, conveys an idea that the tragelaphines originated in Asia, spreading thence to South-eastern Europe and Africa, on the one hand, and even to North America on the other. Amongst the true antelopes themselves, the duykers and neotragines are obviously the most primitive of existing forms, and apparently first developed from the basal stock of the bovids in France or Southern Europe. From them arose the gazelles, or gazelle-like forms, which have "proliferated" in course of time into pallas, topis (Damaliscus), hartebeests, and gnus. The pallas have specialised in some points, such as reduction of the mammæ, but they are very suggestive in others of the vanished link between gazelles and hartebeests. The neotragines, possibly, were ancestral to the Cobus group; and the primitive Cobine stock seems to have given birth to the remarkable orygine sub-family (addax, hippotragus, and oryx).

Mr. Roosevelt's book throws a good deal of light on the problem of the origin and descent of the Bovidæ, even though his or Mr. Heller's theories are not in all points acceptable—at any rate to this reviewer of his book.

The book is most effectively illustrated by photographs, drawings, maps, and diagrams.

H. H. JOHNSTON.

ORGANISATION OF SCIENTIFIC WORK IN INDIA.[1]

THE Board of Scientific Advice for India was established in 1903. When first created it was composed exclusively of, and still includes, the officers for the time being in administrative charge of the various scientific departments of the Government of India. The object primarily in view was to enable the heads of these departments to meet at stated intervals for the purpose of considering the programmes of work proposed to be undertaken by each during a coming season. The number of problems awaiting attention in so vast an area as our Indian Dependency has always been greater than the staffs of the combined scientific departments can ever hope to deal with at any one time. The avoidance of wasted effort is, therefore, in India more urgently essential even than at home. The degree to which interest attaches to problems that lie on the border-line where the activities of cognate departments meet is just as great in India as elsewhere. Questions relating to the soil are of paramount importance in a land in which agriculture is the fundamental industry; such questions often affect the officers of the Geological Survey as much as they do those of the Department of Agriculture. Questions relating to the constituents of an indigenous flora are often only second in importance to those concerning cultivated plants; such questions may be of equal interest to the Botanical Survey and the Forest Service. Yet other questions may be of interest to the zoologist on the one hand, to the veterinary officer, the forester, or the agriculturist on the other.

The high traditions of all branches of the public service in India are of long standing, and to the self-effacement which is so characteristic of her officers has been united a singular absence of jealous rivalry and a peculiar readiness to render mutual aid. Instances of the simultaneous and conscious undertaking by two departments of the investigation of the same problem have therefore been in India remarkably rare. This being the case, the establishment of a Board of Scientific Advice, with as one of its main objects the automatic elimination of overlapping of work, was perhaps less essential than the institution of such a body might be in certain other countries. Still, if in this respect the functions of the Indian Board have scarcely had to be exercised, the existence of such a body remains a desirable precaution, while since the Board was constituted it has proved advantageous by bringing about what it was in a manner constituted to prevent. For when some border-line problem now suggests itself for study to some one department, other departments are in a position to consider, at the outset, its bearing on their own work and interests. Two departments are now sometimes able to deal with one problem, and by simultaneous attack along different lines to secure results which neither department, working alone, might hope to attain in double the time. In connection with this aspect of its activities the Board has, to the public advantage, been strengthened by the addition of scientific men who are not necessarily at the head of Government departments.

Since its inception, this Indian Board has taken into consideration, along with programmes of future work, the progress of inquiries actually in hand and the results of investigations which have been concluded. Such inquiries are made the subject of an annual report. This report by the Board, it should be understood, is not to be taken as a substitute for or even as a *resumé* of the annual reports of the different scientific departments represented thereon. Those who desire to make themselves acquainted with the operations of the Surveyor-General, the Meteorological Reporter, the Inspectors-General of Forestry or of Agriculture, the Directors of the Geological or the Botanical Surveys, must study the official reports issued by these various officers. But the reader who has no such special object in view, yet wishes to form some estimate of the extent to which scientific studies are being systematically prosecuted and scientific results are being economically applied in India, will find in the Report of the Board of Scientific Advice succinct accounts by authorised and competent officers of these scientific activities during a given year.

The report of the Board for 1913–14, which lies before us, testifies to the variety of these activities and to the attention bestowed on investigation and research in India. Among the more generally interesting items in this particular report are an account by Mr. G. T. Walker of the equipment of the Solar Physics Laboratory at Kodaikánal; a note by Mr. H. H. Hayden on the materials available for the construction of Imperial Delhi; a report by Mr. R. C. Burton on the quantity of pitchblende available in the Singar mica mines; the record by Lieut.-Colonel G. P. Lenox-Conyngham of the completion of the Indian portion of the connection between the triangulations of Russia and India; and the more hopeful prospects with regard to the cultivation of the African plant known as *Java* Indigo, reported in a note by Mr. A. Howard of the Pusa Institute. But the whole report repays perusal, while one of its most useful features is the list of publications which accompanies each of its sections.

[1] Annual Report of the Board of Scientific Advice for India for the Year 1913–14. Pp. 175. (Calcutta: Superintendent Government Printing, India, 1915.) Price 1s. 4d.

NOTES.

IT is officially announced that Admiral of the Fleet Lord Fisher of Kilverstone has been appointed chairman of the Inventions Board which is being established to assist the Admiralty in co-ordinating and encouraging scientific effort in its relation to the requirements of the Naval Service. A further announcement will be made as to the *personnel* of the new Board and the address of its offices.

IN reply to a question asked by Sir Philip Magnus in the House of Commons on July 1, the Minister of

Munitions, Mr. Lloyd George, said he was fully alive to the great importance of securing the co-operation of scientific workers, and of utilising so far as practicable the laboratories and workshops of our universities and technical schools for experiments and for making munitions of war. Replying to further questions, Mr. Lloyd George added that he hoped in a very short time to be able to do something in the nature of the work done in France by M. Albert Thomas, who was bringing officers from the Front to confer with members of the Academy of Science; and that he had within the past few days been discussing the question of establishing a central committee or bureau.

IN the House of Lords on July 2, Lord Bryce urged the Government to make every possible effort to utilise the services of scientific men, and said that a call to co-operation would be welcomed by all British chemists and engineers. Replying at the end of the debate, Earl Curzon referred to the surprise expressed that, considering the great resources of scientific ability in this country and the willingness shown by our men of science to be of service, more use had not been made of them. He fancied, he said, a great deal more advantage had been taken of these than was known generally. For instance, a committee of the Royal Society had rendered valuable aid, and the Admiralty and War Office could give a number of cases in which offers of scientific assistance had been accepted and advantage had ensued. He held out the hope that it would be possible to arrange to make still greater use of the services of men of science.

AT the annual general meeting of the British Academy held on June 30, Lord Bryce, president, in the chair, the following were elected Fellows of the Academy:—Mr. H. Stuart-Jones, Director of the British School at Rome 1903–5; Sir Charles Lyall, Prof. D. S. Margoliouth, Mr. W. L. Newman, Sir James H. Ramsay, Bart., of Banff, and Prof. W. R. Scott.

AMONG the recent additions to the zoological department at South Kensington are some specimens which are surely destined to possess historical interest for posterity. They consist only of two or three examples of harvest-mice and one house-mouse, but they were caught in the trenches in northern France, in that part of the trenches, in fact, occupied by some of our Indian troops. These specimens were collected and presented to the museum by one of the officers of an Indian regiment, whose keenness for his favourite pursuit of natural history allowed him in the intervals of being heavily shelled by the enemy a little relaxation in the way of trapping and skinning any animals for the national museum in London.

THE council of the Royal Society of Edinburgh has awarded the Makdougall-Brisbane prize for the biennial period 1912–14 to Prof. C. R. Marshall, Dundee and St. Andrews, for his studies on the pharmacological action of tetra-alkyl ammonium compounds. The prize and medal were presented at the meeting of July 5. These researches of Prof. Marshall's may be described as the direct outcome of investigations which were published in the Transactions of the Royal Society of Edinburgh by Prof. Crum Brown and Sir Thomas Fraser in 1869—more than forty-five years ago—and have been continued since by various pharmacologists, amongst others by two distinguished graduates of Edinburgh University working in collaboration, Sir Lauder Brunton and Prof. Theodore Cash, whose work was published in the Philosophical Transactions of the Royal Society in 1884.

THE council of the Salmon and Trout Association is seeking data as to the possibility of increasing the supply of fly-food in trout streams, and is inviting anglers and fishery owners to give details of cases in which the valuable water-bred flies have been increased substantially in number by any special measures such as the introduction, by the planting of eggs or larvæ, or the liberation of mature flies on the banks of a river or lake; and the improvement of a stream or lake by the cultivation of special weeds, careful removal of mud, and so on. The tabulation of specific results, with an account of the measures taken, would be of interest and value, and if sufficient information is forthcoming, it is hoped to publish it in the association's quarterly journal, the *Salmon and Trout Magazine*. Communications, addressed to the honorary secretary, Sir Wrench Towse, or to the editor of the magazine, Fishmongers' Hall, London, E.C., will be acknowledged.

THE death is announced, at seventy-seven years of age, of Mr. F. E. Kitchener, who served as Assistant Commissioner to the Royal Commission on Secondary Education, and was the author of a "Geometrical Note-Book," "Naked Eye Botany," and other works.

WE regret to record the death, at Dulwich, on June 26, of Mr. A. C. Hurtzig. Some particulars of his career are given in the *Engineer* for July 2. Mr. Hurtzig was born in September, 1853, and was educated at Ware Grammar School and at University College, London, where he was one of the earliest students in the engineering faculty. His early experience was gained on railways and harbours in Ireland. In 1888 he became chief assistant to Sir John Fowler and Sir Benjamin Baker. Sir John Fowler died in 1898, and, on the death of Sir Benjamin Baker, Mr. Hurtzig became head of the firm. He completed Sir Benjamin Baker's work for the Egyptian Government in respect of the raising of the Assuan Dam and the building of the Isna barrage, and was engineer of the Forth Bridge Railway Company to the time of his death. He was a member of the Institution of Civil Engineers, and also of the Iron and Steel Institute.

MR. C. E. P. SPAGNOLETTI, a well-known British electrical engineer, of Italian origin, who was born at Brompton in July, 1832, died at Hampstead on June 28. He was employed by the Electric Telegraph Company from 1847 until 1855, when he entered the service of the Great Western Railway as chief of their telegraphic department. He remained chief electrician and telegraph engineer of that railway company for thirty-seven years. In 1865 the London Metropolitan Rail-

way was opened and worked on the Great Western Railway system, and in the same year Mr. Spagnoletti brought out his disc-block instrument for controlling the traffic on the Metropolitan lines. He was responsible also for numerous other electrical appliances for use on railways. He became consulting engineer to the City and South London Railway in 1889. Mr. Spagnoletti was president, in 1885, of the Society of Telegraph Engineers and Electricians (now the Institution of Electrical Engineers), a member of the Institution of Civil Engineers, of the Royal Society of Arts, and of the Physical Society.

DR. ROBERT HEATH LOCK, whose untimely death was recorded in NATURE of July 1, was born in 1879. From Charterhouse he entered Gonville and Caius College as a scholar in 1899. After distinguishing himself in the Natural Sciences Tripos, he became Frank Smart student of the college, and was elected a fellow two years later. Lock took his degree at the time when the rediscovery of Mendel's work opened up new possibilities of research for the botanist. Through the influence of Bateson, these possibilities were at once recognised in Cambridge, and Lock determined to go to the tropics in order to start experimental work on Mendelian lines. He proceeded to the well-known Botanic Gardens of Peradeniya in Ceylon, and for several years was busily engaged in breeding work with maize and peas. Both these plants, especially the former, lend themselves readily to the recording of considerable numbers of observations. Lock took full advantage of this, and the extensive data he obtained—in one set of experiments with maize more than 50,000 records were made—made it clear that for certain characters, such as the white and yellow colour of maize seeds, the Mendelian rule of segregation was exhibited with remarkable accuracy. His experiments with peas confirmed his conclusions from those with maize, and he further published some interesting results on more complicated Mendelian phenomena. He returned to England in 1905, when he became curator of the herbarium at Cambridge, and did valuable work in organising the library of the botanical department. At the same time he started experiments with Nicotiana, of which an account afterwards appeared in the Journal of the Royal Botanic Gardens of Peradeniya. In 1908 he returned to Peradeniya as assistant-director. Shortly afterwards he became acting-director, in which position the demands on his time practically put a stop to his own researches, though he did much useful work in connection with the rapidly growing rubber industry. Changes in the administration of the Peradeniya Gardens brought him back to England once more, when he took up the post of inspector under the Board of Agriculture, which he held until the time of his death. Lock's work did much towards laying a sound foundation for genetic science, the results of which he helped to popularise in a clearly written little book. His record makes us regret that the cares of administrative work should have prevented his following up his earlier successes in research.

IN a lecture before the British Astronomical Association on Wednesday, June 30, on recent developments in the applications of electricity to precision clocks for observatories, Mr. F. Hope-Jones, chairman of the Wireless Society of London, spoke feelingly of the loss of the wireless time-signals in war time. Throughout the year 1913 and until early in August last, when all privately owned wireless installations were dismantled by order of the Postmaster-General, the rhythmic signals were observed every night at 11.30; and by means of the "acoustic vernier" the rate of an astronomical regulator running on test was determined in hundredths of a second. Since then the old laborious method of testing and rating has had to be reverted to, requiring months instead of days. Referring to the fight for freedom to listen to the international wireless time-service signals without taxation, and its successful issue shortly before the war, Mr. Hope-Jones expressed the hope that these privileges would be restored in their entirety on declaration of peace. When that day arrived, it might be necessary for the scientific world to act in concert and present this claim with unanimity and force.

THE Scripps Institution at La Jolla, near San Diego, California, is, says *Science*, to have its facilities improved. Miss E. B. Scripps has announced to the University of California her intention to give during the next two years 20,000*l*. for further equipment. A pier a thousand feet in length will be built, at which can lie the *Alexander Agassiz*, the sea-going vessel owned by the institution and used exclusively for its work. Additional aquarium facilities will be provided, all planned to be useful for scientific purposes, but in part to be available for public educational objects. A salt-water pumping plant and settling basin are also to be added. Quarters for scientific assistants and graduate students are also to be arranged. The Scripps Institution has a site of 177 acres, with half a mile of ocean frontage, well-equipped laboratories, residences for the scientific staff, a good working library, and excellent equipment. The land was given by the city of San Diego, while for the most part the other equipment has come by the gift of Miss Scripps, who has created also an endowment of 30,000*l*. for its work. The State of California gives to the University of California 1500*l*. per annum as a contribution towards the work of the institution, and the director, Mr. E. Ritter, and his staff give their whole time to the research work.

THE leading article in *Engineering* for July 2 is devoted to a discussion on French and German guns. An explanation has been given by M. R. Arnoux before the French Society of Civil Engineers of the cause of death produced by the bursting of French 75 mm. and other high-explosive shells. From evidence furnished by a pocket aneroid barometer which had been rendered unserviceable by the explosion close to it of a German high-explosive shell, it appears that the explosion had produced, at a distance of fewer than 3 metres, a sudden barometric depression in the room where the instrument was placed of at least 350 mm. of mercury, corresponding to a driving velocity of the air of 276 metres per second, and to a dynamic pressure of 10,360 kilograms per square metre. In the case of men sheltered behind

any kind of protection, the very sudden static depression of the surrounding atmosphere comes into play, and many are killed without signs of wounds. The explanation put forward is that the air and carbonic acid in solution in the blood are disengaged in the shape of minute gaseous bubbles as soon as the pressure decreases too suddenly from any cause. These bubbles are driven into the small arteries under the influence of the pressure exerted by the heart. If their diameter is greater than that of the small arteries, they form so many gaseous plugs, which instantaneously stop the blood circulation, and death occurs before there is time for them to dissolve back in the blood when the ambient atmospheric pressure returns to normal. The radius of action of high-explosive shells is less than the possible one of shrapnel for killing purposes, but they are more deadly than shrapnel, for in their radius of action no living being escapes, whilst the shrapnel is dangerous only when one of its balls or fragments strikes home.

THE report of the Marlborough College Natural History Society has just reached us. It contains one feature which the reports of other public schools might well follow. This is the Anthropometrical Report, giving the height, weight, and chest measurements of boys weighed during February, May, and October, 1914. This is an extremely useful piece of work, and might well be extended to include other details, such as the span of the arms, hair and eye colour, and the cephalic index. The sectional reports—zoological, botanical, and photographic—all give proof of keenness and shrewdness of observation.

A BRIEF but excellent summary of the life-history of the woodlark, by Mr. W. Farren, appears in *Wild Life* for June. The author's observations were made in the Breck district of Cambridgeshire, where this bird appears to be on the increase owing to the extension of plantations. He makes some interesting comparisons between this species and its ally, the skylark, more especially in regard to the method of feeding the young. The woodlark, it would seem, suffers an unusually high infant mortality owing to the raids of mice on the eggs and very young nestlings. Some very beautiful photographs add much to the value of this short essay.

IN connection with the article in NATURE of June 17 on "Jamaica as a Centre for Botanical Research in the Tropics," it is desirable that attention should be directed to the interesting descriptive account of the laboratory and garden at Cinchona, given by Prof. Duncan S. Johnson in the *Popular Science Monthly*, vol. lxxxv., No. 6, 1914, and vol. lxxxvi., No. 1, 1915. The history of Cinchona, which was established in 1869, is given, and is followed by an excellent account of the laboratory and the magnificent tropical vegetation by which it is surrounded. The articles are illustrated by numerous photographic reproductions, in which the luxuriance of the tree-fern growth in particular is well shown.

THE dire consequences of the reckless destruction of timber on the Victorian "flood-plain" are convincingly shown by Mr. J. G. O'Donohue in the *Victorian Naturalist* for May. Barren, treeless wastes of huge extent now mark the sites of once flourishing forests. No use is made of the clearings thus made, which have become, indeed, a source of danger to the Murray River, rendering its navigation more difficult each year owing to the detritus carried into it by the storm and flood waters now that the vegetation no longer serves as a filter and to hold the soil. The observations on the animal life and the botany of the area explored make profitable reading. Among other things he comments on the ravages caused among the aborigines by smallpox. Hundreds of bodies lay buried in one of the sand-dunes he traversed, and some of them were disinterred. In the course of his stay in this region he gathered conclusive evidence disposing of the oft-repeated statement that the doe kangaroo, when hard pressed, deliberately throws her young one from her pouch. The ejection invariably and unintentionally follows on a long pursuit. The young one is "sent spinning from the pouch as the mother, by her enormous leaps, imparts to it a more or less vertical motion."

IN view of the number of deaths from anthrax that occur among those employed in the leather industry, especially in the handling of imported hides, a paper in the *Journal of Agricultural Research*, vol. iv., No. 1, on the disinfection of hides infected with anthrax spores, has more than ordinary interest. Mr. F. W. Tilley has investigated the efficiency of the Seymour-Jones and Schattenfroh methods which have been proposed during the last few years. The problem is difficult owing to the high resistance of anthrax spores and the necessity that the hides shall not be injuriously affected from the tanner's point of view. The author finds that the strength of disinfectant originally recommended by Seymour-Jones (mercuric chloride 1 in 5000 plus 1 per cent. formic acid) is not efficient, but 1 in 2500 is efficient if the hides are not subjected to a neutralising solution for a week or two after disinfection. If, however, the hides are immersed in sodium sulphide, as ordinarily used by tanners for dehairing, within three or four days of disinfection, even this higher strength is not sufficient to prevent fatal infection to guinea-pigs from disinfected material. For this reason the process is recommended only when the hides are treated at the port of shipment. The Schattenfroh method (2 per cent. hydrochloric acid plus 10 per cent. sodium chloride) proved entirely satisfactory from the bacteriological point of view, forty-eight hours' exposure proving efficient in every instance. Sevčik, however, has reported that while with thin hides the results were good, thick, heavily infected hides were found to contain spores virulent to mice even after seven days' exposure. The author nevertheless thinks that the Schattenfroh method is so far superior to other methods as to be well worth a trial as a standard process of disinfection for hides. Pieces of hide treated by both methods were found to be uninjured after passing through the usual tanning processes.

IN recent years German and Austrian anatomists have devoted much attention to the possibility of reconstructing the likeness of a person when merely

the bones of the head and face remain to serve them as a guide. The matter has also been taken up by anatomists in America. Recently Prof. Charles W. M. Poynter, of the University of Nebraska, handed three human skulls to an artist with the request that the soft parts of the face and head might be reconstructed according to the data published by Prof. von Eggeling, of the University of Jena. The artist did not know that the three skulls belonged to natives of North America, one being a skull found in a Nebraska loess mound by Mr. Robert F. Gilder, and possibly of Pleistocene age, another belonged to an Indian of pre-Columbian date, while the third was that of a modern Indian. Photographs of the plastic reconstructions made by the artist have been published in the illustrated Press of America, the American-Indian type of countenance being very apparent in all three. Whatever the age of the Nebraska loess skull may prove to be, there can be no doubt, from its osteological characters, that its owner was a man of the Indian type. The plastic reconstructions show that the artist had come unconsciously to the same conclusion.

THE appointment of Dr. R. E. Fries to the directorship of the Bergielund Botanic Garden is recorded in *Kew Bulletin* No. 4. Dr. Fries, who has travelled widely in South America and published extensively in various domains of botany, carries on the botanical traditions of his father, Prof. T. M. Fries, and his grandfather, E. M. Fries, the brilliant expositor of the Fungi. The Bergielund garden is at Albano, near Stockholm, and was bequeathed to the Royal Academy of Science by Bergius, the pupil of Linnæus, well known for his work on Cape plants. His bequest, in addition to the garden of 17 acres, comprised his extensive library and herbarium as well as much of his estate.

MISS MAUD D. HAVILAND records some very interesting observations, which have the additional merit of being for the most part new, on the courtship of the lapwing in the *Zoologist* for June. Under the term "courtship" she includes all behaviour that is peculiar to the bird in spring time, but the only emotional display, she contends, which is to be interpreted as a deliberate display to a prospective mate, is the exhibition of the richly coloured chestnut under tail-coverts. Miss Haviland confirms the view that the amatory exercises of these birds take place within a circumscribed area, more or less distant from the nesting place. While making no claim to originality for her interpretation of the origin of nest-building, she makes some trenchant criticisms on certain grotesque theories which have been propounded on this subject.

THE recently issued number (tome xiv., 1914) of the *Bulletin du Jardin Impérial Botanique de Pierre le Grand* contains several interesting papers in Russian, which, fortunately, are provided with summaries in French. Mlle. Ljabitzkaja contributes an account illustrated with excellent plates dealing with the various forms of *Leucobryum glaucum*, the moss which occurs in the form of free, rounded, disc-like masses with radially arranged stems sometimes met with in England. A map of the distribution of the various forms in Russia is also included. The author considers that only the single species, *L. glaucum*, occurs in Europe, the ball-like form being var. *subsecundum*. The moss, except in the west of the Caucasus, is always infertile, and the author considers the fertile form of the Czemomorsk region to be a new variety, which he calls var. *gracile*.

IN continuation of the series of researches on the development of minerals from igneous magmas, which we owe to workers in the United States, Mr. Olaf Andersen has examined the supposed binary system, $CaAl_2Si_2O_8-MgSiO_3$ (*American Journal of Science*, vol. xxxix., p. 408). The $MgSiO_3$ constituent proved to be unstable at its melting point, breaking up into forsterite and a melt. Silica appeared as cristobalite and tridymite. In certain mixtures, moreover, spinel arose, deriving its alumina from the anorthite molecule, which also became unstable. Spinel is in consequence regarded as originating in igneous rocks from a homogeneous magma. The crystallisation of forsterite under the conditions of the experiments is interestingly shown to explain the known relations between olivine and pyroxene in igneous rocks.

THE Geological Survey of Great Britain, since our notice at the end of April (NATURE, vol. xcv., p. 242), has issued a memoir to Sheet 269, price 2*s*. 6*d*., on the country around Windsor and Chertsey. The authors, Messrs. Dewey and Bromehead, show how the commanding site chosen for Windsor Castle is due to the erosion of an anticline of chalk, which here rises from beneath the level Cainozoic beds. It will be new to many readers that the Ditrupa sandstones in the London Clay are capable of forming waterfalls in the local streams. The sequence of flint implements in the gravel-terraces is discussed. The Scottish Branch gives us a memoir to Sheet 74, on the difficult country of Mid-Strathspey and Strathearn (price 2*s*. 6*d*.). The great alluvial cones and terraces connected with overflow-channels of glacial days are finely illustrated. The book is one that will add greatly to the pleasure of any intelligent visitor to Aviemore and the historic Grampian road.

THE severe thunderstorm which passed over the central parts of London on the evening of May 6 is dealt with in *Symons's Meteorological Magazine*. A map is given which shows very clearly the limited area over which the rainfall was heavy. Only four rainfall records have been received from the six square miles which embrace the region with a rainfall of more than 1·5 in. The measurements are 1·70 in. at Messrs. Negretti and Zambra's premises at Holborn Viaduct; 1·76 in. at Mr. Steward's in the Strand; 3·00 in. at the Holborn Borough Stone Yard; and 3·12 in. at New River Head, the office of the Northern District of the Metropolitan Water Board. It is stated that more than 3 in. of rain possibly fell on an area, about half a mile wide and a mile and a half long, between the City and King's Cross. Mr. J. M. Wood, Engineer for the Northern District of the Metropolitan Water Board, made the following careful and interesting report. "On Thursday evening, the 6th instant,

I recorded 3·12 in. of rain between 8.30 p.m. and 10 p.m., due to the thunderstorm. There can be no doubt about the time and quantity, as I had the rain-gauge checked by tanks and trucks which stood close by."

A SCIENTIFIC paper recently issued by the Bureau of Standards deals with the emissivities of metals and oxides at temperatures near their melting points. The work is by Messrs. G. K. Burgess and R. G. Waltenberg, who use throughout the micropyrometer invented by the former three years ago. A speck of the substance weighing about a hundredth of a milligram is placed on a platinum strip which can be heated in an atmosphere of air, hydrogen, or other gas until the substance melts. On cooling it presents a smooth, clean surface. The carbon or tungsten filament of the micropyrometer is then brought alternately to the same brightness as the bare and as the covered platinum when viewed through coloured glasses. The emissivity of platinum being known for all the temperatures used, the temperatures and emissivities of the substances can be calculated. For the wave-lengths at which the comparisons are made the metals do not appear to change their emissivities much in the 20° C. below their melting points, but some of them and some of their oxides show a marked increase of emissivity on melting. This increase of emissivity on melting in the case of platinum makes the Violle unit of light uncertain.

THE Economic Proceedings of the Royal Dublin Society (vol. ii., No. 10, p. 161) contains an account by Prof. G. T. Morgan and Mr. G. E. Scharff of preliminary experiments on the utilisation of peat tar. The tar produced by distilling peat in retorts, producer gas plants, or other suitable distilling apparatus, yields certain neutral oils which differ from the aromatic oils of coal tar and from the paraffins in having a highly unsaturated character manifested by the rapid absorption of atmospheric oxygen. The alkaline extraction of these oils leads to the separation of acidic oils of high boiling point and of great germicidal power. The higher fractions of the neutral oils yield waxes resembling the Montana wax of lignite. The crude peat tar oil contains small amounts of basic substances of the pyridine group, whilst the residue of the distillation is a typical soft pitch.

AN interesting paper on a greatly improved hæmin test for blood is published by Dr. William Beam and Mr. Gilbert A. Freak in the *Biochemical Journal* (vol ix., p. 161). The difficulties experienced with Teichmann's test when applied to stains, both fresh and old, are due chiefly to the too rapid evaporation of the solvent, and, to a less extent, to interference of the albuminous matter of the blood with the crystallisation. Evaporation should be extremely slow, and when carried out in the manner detailed in the original paper, which also eliminates the harmful effect of albumin, crystals are obtained with the greatest certainty and of remarkably large size, even though only a minute amount of blood be present. The test as described was found to be equally applicable to bloodstains, fresh or even twelve years old, stains partially removed by soap and water or heated to 110°, or mixed with earth, or to old stains on rusty iron which had been exposed to strong sunlight and atmospheric conditions during several days. Of the reagents which have been recommended for Teichmann's test, acetic acid is by far the best. It suffices for the test with bloodstains which have not been extracted with water, but as a precautionary measure it is best to use a reagent containing a minute proportion—about 0·01 per cent.—of sodium chloride.

THE Journal of the Society of Chemical Industry (vol. xxxiv., No. 10, May 31) contains an account by Dr. E. Howard Tripp of a novel system of sewage treatment, called the Dickson centrifuge process. The Dickson method of separating the solids from sludge consists in treating it with 0·5 per cent. of yeast for twenty-four hours at 33° C. Owing to the escape of gases set free by anaerobic fermentation, the solids rise to the surface, from which they are run off; in this manner fully half the water-content of the sludge is eliminated. Live brewer's yeast is the most effective agent, but dextrose, starch, and other substances which act as nutrients to the bacteria, produce the same result. The separated sludge is then completely dried by exposure to hot air in a plant which resembles that used in France for drying pulverised coal-dust. The dried material contains 3 per cent. of nitrogen and 50 per cent. of organic matter, and has proved itself to be a valuable fertiliser, either alone or as a base for artificials. The centrifuge treatment of effluents of all kinds consists in passing them through a centrifugal machine the perimeter of which is perforated and covered with a layer of sand. In its passage through the interstices of the sand, a bad effluent is completely oxidised and becomes supersaturated with oxygen; if it be further treated in a small contact bed and again centrifuged, the purification, both chemical and bacteriological, appears to be complete. The city analyst of Winnipeg found that the reduction of bacteria in a sewage effluent was from 8,150,000 to 1,150,000 per c.c., and that the *B. coli* were completely eliminated.

A PROBLEM which is perpetually presenting itself in chemical work is to distinguish "mere" polymorphism from the more labile types of isomerism and polymerism. Perhaps the most conspicuous illustration is that of ice, which exists in several dense, as well as in one or more light, modifications; it is suspected that all the dense modifications may be polymorphous forms of dihydrol, H_4O_2, and that all the modifications which are lighter than water may be polymorphous forms of trihydrol, H_6O_3; but it is not easy to prove whether this view is correct or not. In the case of certain optically-active substances, such as the two varieties of glucose, conclusive evidence of isomerism or polymerism is found in the fact that freshly prepared solutions of the two forms exhibit unequal rotatory powers, gradually converging to a common value as a condition of equilibrium is attained; if the difference had consisted merely in the dissimilar marshalling of identical molecules in the crystals, every point of contrast would have disappeared instantly on dissolution or fusion. Unfor-

tunately optical activity is an exceptional attribute, and a method depending on solubility which has been described recently by Mr. N. V. Sidgwick, in the Journal of the Chemical Society (vol. cvii., p. 672), promises to become applicable on a somewhat wider scale. The isomerism of the two forms of benzoylcamphor has been confirmed by the new method, and similar phenomena have been detected in two additional cases. Negative results indicate that in other cases the modifications may be due to polymorphism, but this conclusion can only be tentative, as identical results would be produced by rapid isomeric or polymeric changes.

OUR ASTRONOMICAL COLUMN.

THE METEOR SEASON.—Mr. Denning writes:—"There is a special season for many things, and meteors have their more favourable times and periods. Astronomers generally regard the months of August and November as the particular dates when meteors are abundantly displayed. There is substantial ground for this idea. August and November are memorable as having been the months of occasional brilliant exhibitions of meteors in the modern past. In more ancient times July and October were the favoured months by the same meteoric systems, which have slowly advanced in their dates owing to changes in astronomical conditions. To the regular observer the meteoric season may be said to open at about the middle of July, when there occurs a decided increase in the visible number of meteors contemporary with the first oncoming of the Great Perseid shower. We may usually observe twice as many meteors during the last half of July as in the first half. This is not wholly due to the activity of two or three special showers, but is partly attributable to a general increase in meteoric phenomena. July often affords a most agreeable recompense to the observer in supplying plenty of interesting objects, and this is always appreciated after their rarity in preceding months. Thus in June, 1915, at Bristol, only thirty-six meteors were seen in watches of the sky extending over 20½ hours, a degree of scarcity which I never remember to have previously experienced. The Perseids ought to be splendidly witnessed this year with suitable weather about August 9–13. The path of the larger meteors should be carefully recorded, also the time when the maximum number of meteors is visible."

DISPLACEMENTS OF ENHANCED IRON LINES AT CENTRE OF THE SUN'S DISC.—The general displacement of the solar lines towards the red has been interpreted at the Kodaikanal Observatory as due to movements of the solar gases in the line of sight and not to pressure; the movement is one of recession from the earth or a falling movement at the centre of the sun's disc. Thus a circulation of the solar gases is suggested, the cooler gases falling and being replaced by the hotter gases ascending from below; such a circulation might account for the relatively great intensity of the enhanced lines of iron and other substances in eclipse spectra as compared with their intensities in the Frauenhofer spectrum. With a view to detect the rising movement of the hotter gases, Dr. Evershed and Naragana Ayyar (Kodaikanal Observatory Bulletin 46) have made a special study of the enhanced lines of iron in the sun and in the electric arc, the results of which they now publish. Details are given as to the spectrograph employed, method of producing the enhanced lines, times of exposure, etc., and a table is published showing the shifts of enhanced lines at the centre of the sun's disc. The list gives the results for sixteen lines which are of sufficient intensity for accurate measurement, and in every case except one these enhanced lines give positive shifts, showing that they cannot represent ascending gases as was supposed. Investigating the possibility of any relative shift between the enhanced and ordinary lines they find that there is none. Then they conclude "that the enhanced lines of iron in the sun give therefore no evidence of a radial circulation of the solar gases nor of any relative movement compared with the arc lines."

THE MAXIMUM BRIGHTNESS OF VENUS.—M. Henry Rey describes in the June number of *L'Astronomie* some measures that he made with M. Comas Sola on the comparative brightness of Venus and Sirius. Taking advantage of a particularly clear evening at Barcelona on March 25 in 1913, when the planet Venus was at her period of maximum brightness, they secured a series of photographs of the planet and Sirius (out of focus) on the same photographic plate. In the case of the latter the size of the image was so adjusted as to be equal to that of the planet. The durations of the exposures were 2, 4, 6, 8, and 10 seconds for the planet, and 25 seconds 1, 2, 3, 4, 5 minutes for the star. A comparison of the discs led to the conclusion that 10 seconds on Venus equalled two minutes on Sirius, or that Venus was twelve times brighter than Sirius. Thus the magnitude of Venus would be 6·72, Sirius being −1·4. Another communication on the same subject, by M. Salvador Raurich, appears in the same journal, and gives the brightness of Venus as nine times that of Sirius, nineteen to twenty times that of Aldebaran, and five times that of Jupiter.

CAUSES OF CHANGES IN THE RATE OF A WATCH.—There are no doubt many amateur astronomers who depend for their time on watches, and now that wireless time-signals cannot be received, they have to trust to their rates for longer periods than was then necessary. When such watches are taken out of the pocket and hung up or placed on a rest for the night the change in the rate is liable to many vicissitudes. Such variations can amount to a considerable quantity, and an interesting note on this subject appears in the May number of the Monthly Notices of the Royal Astronomical Society, by Mr. J. J. Shaw. In his concluding remarks the author states that "since writing the foregoing, it has been brought to my knowledge that the late Lord Kelvin made some similar experiments with watches," particulars of which were given in his "Popular Lectures," vol. ii., p. 360. The subject is, nevertheless, of such practical importance that attention may be directed to Mr. Shaw's communication. The chief moral to be drawn is, do not hang your watch up on a hook or nail unless precautions are taken to prevent the watch from oscillating. If you do, then an oscillation may be set up, under the influence of the watch's own balance-wheel, which will change the rate from a fraction of a second a day to one of many seconds or even to a quarter or more of a minute.

THE BRITISH SCIENCE GUILD.

THE ninth annual meeting of the British Science Guild was held on Thursday, July 1, the chair being taken by the president, the Right Hon. Sir William Mather. In opening the proceedings, the president expressed regret that owing to weak health Sir Norman Lockyer, chairman of the Executive Committee, and the founder of the guild, was unable to be present. Referring to the presidential address to the

British Association in 1903, on the necessity for the culture of science in all the affairs of life, Sir William Mather remarked:—"I venture to believe that we could claim for Sir Norman Lockyer the character of a prophet, for foreseeing, as he appears to have done, the movements of the world which have come to pass since, and more especially the great need, in regard to English culture and education generally, for more thorough scientific training. Had what he then proposed been carried out the effects at the present time would have been very greatly to our advantage as a nation."

The ninth annual report of the guild was adopted on the motion of Sir Boverton Redwood, seconded by Col. Sir John Young. The report was summarised by Sir Boverton Redwood as follows:—The activities of the guild have been well sustained during the past year, notwithstanding the war; and, in fact, in certain directions the guild has rendered services to the country in dealing with difficulties which the war has created. As in former years, the report reviews the action of the Government in the appointment of Royal Commissions, Departmental and other Committees that deal with matters in which the guild is interested. It is satisfactory to note that some progress has thus been made in enlisting the services of men of science and technologists, and it is still more gratifying to Sir Norman Lockyer and other members of the guild who have long advocated such an action, that the President of the Board of Education is proceeding with the scheme outlined by his predecessor for the co-ordination of higher education, and especially of higher technical education, with the object of developing industries in this country. Under the guidance of Sir Ronald Ross the medical committee, in common with other committees of the guild, has been chiefly occupied with matters arising out of the war. The action taken by the committee in strongly condemning the unpatriotic attempt to throw discredit on the practice of inoculation against typhoid may be specially mentioned. The attention of the Executive Committee having been directed to questions, in connection with science and the State and the encouragement of discovery, raised in Sir Ronald Ross's address to the members of the guild at the annual general meeting of the guild at the Mansion House in May, 1914, it was decided to appoint a special committee to consider and report on the matter, and especially to consider the desirability of increasing the financial support given by the Government for the higher forms of intellectual effort, and adequate remuneration of scientific workers and learned societies for services rendered in connection with Royal Commissions and Departmental and other Committees. This inquiry has not yet been completed, but considerable progress has been made.

In September last, the attention of the Board of Trade was directed to the effect of the war in putting a stop to the import from Germany of glass and glass apparatus, and to the possibility of taking advantage of the opportunity thus afforded of extending the manufacture of glass in this country. In this connection, Lord Moulton, as chairman of the Technical Sub-Committee of the committee appointed by the Board of Trade, referred this matter to the guild for consideration, and the guild deferred it in turn to the Technical Optics Committee. A report was presented stating that proper provision should be made at the National Physical Laboratory for the examination of samples of glass as to their physical and optical properties, and that the director of the laboratory should be approached on the subject. It was also proposed that facilities should be provided for carrying out at the National Physical Laboratory or elsewhere of the research connected with the manufacture of the optical glass referred to in the report; that steps should be taken as speedily as possible to give effect to the previous recommendations of the Technical Optics Committee in the direction of providing facilities for the systematic scientific and manual training in technical optics; and since this training requires time, the committee is strongly of opinion that the question is urgent and that organisation should be taken in hand at once.

Since this report was put in print the Executive Committee has learned with satisfaction that steps have been taken by the Government to give effect to the first two of the recommendations. In regard to the supply of chemical glass apparatus which, prior to the war, had been largely obtained from Germany and Austria, the guild, through the joint action of its Education Committee and Technical Education Committee, has been able to secure from a large number of the principal educational institutions assurances of support to British makers; and has done much valuable work in obtaining information as to the types and sizes of glass apparatus in greatest demand for the guidance of those who are engaged in meeting the present deficiencies in supplies.

Sir Philip Magnus, in moving the election of the Executive Committee and of the Right Hon. the Lord Mayor as a vice-president, said that at no period in our history was it more important than it is now that our country should avail itself of the services of its scientific men. It is absolutely essential that we should avail ourselves of the help which can be given by scientific men in this war, and a very important duty falls on the Executive Committee of this guild to organise or assist in organising these efforts. At the present time we are considering in the House of Commons a Bill described as the Munitions of War Bill. The object of that Bill is to make provision for furthering the efficient manufacture, transport, and supply of munitions for the present war and other purposes incidental thereto. When one looks at the contents of that Bill, the consideration and discussion of which took place a few nights ago on the first and second reading, there is no reference whatever to the assistance which science might be enabled to give to the very objects with which the Bill has been promoted. The whole of the Bill and the discussion in which it was introduced referred simply to the relation of employers to employed, and the condition under which the working classes may be willing to give their assistance.

I have been using my endeavours so far as possible to discover what steps our Government are at present taking to carry out the object to which Sir William Ramsay will refer in his address. It seems to me very desirable that all our departments of State should act in co-operation with each other so as to prevent any overlapping of effort in the endeavours to apply science to the varied requirements of the war, so I asked the Minister of Munitions if he could make a statement as to the steps that have been taken, and are about to be taken, for co-ordinating, for war purposes, the services of men of science, and for utilising the laboratories and workshops of our universities and technical schools for experiments, and for the making of munitions of war or parts thereof; and whether it is intended to establish, as has been suggested, a central committee or bureau for dealing with inventions and practical scientific questions incidental to the operation of the war. The answer I received was fairly satisfactory so far as it goes. It was as follows:—"I am fully alive to the great importance of securing the co-operation of scientific workers through-

out the country, and of utilising so far as practicable the laboratories and workshops of our universities and technical schools for such purposes as those alluded to in the question. I am not at present able to make a detailed statement as to the points raised in the last part of the question. I take this opportunity of expressing my appreciation of the valuable help which is already being ungrudgingly given to the Ministry of Munitions by men of science and scientific authorities and institutions."

To a great extent that is a very satisfactory reply, and from all I have been able to learn I feel convinced that great efforts are being made at the present time by the Minister of Munitions and by the advisers of the War Office to utilise the services of scientific men, and I need scarcely point out that the Royal Society is doing all it possibly can with the view of helping the Government in the important objects which it has undertaken, but I am very desirous of urging upon the Executive Committee of the guild that it should use all its efforts to bring about co-operation between these various departments, so that some controlling power may be established which shall be in direct connection with the various Departments of State, and through which, from these departments, shall be forwarded all the various important questions with which those departments have to deal.

After the motion for the election of the Executive Committee and the new vice-president had been seconded by Prof. Perry, and carried by the meeting, Sir William Ramsay delivered an address, the main part of which is subjoined.

THE NATIONAL ORGANISATION OF SCIENCE.

Sixty-three years ago, Dr. Lyon Playfair, afterwards Lord Playfair, gave an address on "Industrial Instruction on the Continent," in which he endeavoured to arouse interest in the applications of science to industry. In it he remarked:—"For many years foreign States, acting upon the facilities for communication, have expended annually large sums in sending highly enlightened men to our country, for the purpose of culling from our experience, and of importing it into their own land; and we see the effect of the experience thus readily acquired, when united with the high development of mental labour, in the rapid growth of new industries abroad. We still hold to mere experience as the sheet anchor of this country, forgetful that the moulds in which it was cast are of antique shape, and ignorant that new currents have swept away the sand which formerly held it fast, so that we are in imminent risk of being drifted ashore. In fact, this is the great question at issue between England and foreign States. With us, there is a widespread jealousy of science, and a supposed antagonism between it and practice. . . . While we continue to rely upon local advantages and acquired experience, we allow a vast power to arise abroad which is already telling against us with wonderful effect."

Reiterated appeals have been made to various Governments in power since that address was delivered; twenty years later, a Royal Commission was appointed under the presidency of the then Duke of Devonshire, which unanimously recommended that a science council should be appointed by the State. Our Science Guild originated as the outcome of a similar appeal made by Sir Norman Lockyer in his presidential address to the British Association, when it met at Southport in 1903.

Our existence as a nation is threatened. Although I am and have been for many years an advocate of compulsory military service, I cannot but admire the response to the call to arms by the Minister of War. But it is not enough. Every man and woman must aid in combating the enemy. Words are incapable of expressing the detestation with which we all view the stupid and vicious methods which the Germans have adopted; but we cannot deny that the German people have been carefully organised, and that it will need every effort on our part, and on that of our Allies, to defeat their armies.

The French Academy of Sciences, at a general meeting on August 4, offered to its Government all its resources in aid of national defence. Committees were immediately constituted, and the Under-Secretary of State for War placed at the disposal of these committees the services of officers equipped with full knowledge of the requirements of the War Office.

On October 29 I wrote an article which appeared in NATURE, from which I may be allowed to quote the following passage:—"There is a class of our fellow-subjects which has yet, so far as I am aware, not been organised. That is the fellows of the Royal, the Chemical, and the Engineering Societies. In their own particular provinces they are the pick of the brain of the country. This war, in contradistinction to all previous wars, is a war in which pure and applied science plays a conspicuous part. Has any attempt been made to co-ordinate the efforts of the devotees of physical, chemical, and engineering science, so that they may work together at what for us is the supreme problem of all—how to conquer the Germans? For if we fail, civilisation as we know it will disappear." This is the first of July, and such an organisation has yet to be created.

Now it is exceedingly difficult to speak openly on this matter; for certain steps have been taken. One, known to the public, is the appointment of Lord Moulton as a general adviser; his efforts were concentrated first on the establishment of a colour industry; and we understand that he has now the task of organising the supply of munitions of war. Doubtless much has been done; but neither the general public nor the fellows of the various scientific societies have any special knowledge of what has been, and what is being, accomplished. If he has consulted anyone, that has been done privately. It is believed that a small committee was appointed to advise on the colour question; but here again we have no definite knowledge. Another fact in public view is the appointment of Mr. Lloyd George as Minister of Munitions. His counsel to the operatives is doubtless valuable. Here, again, a committee is being nominated.

A deputation of the Royal and Chemical Societies, and of the Societies of Public Analysts and of Chemical Industry, had an interview with the President of the Board of Trade on May 6; with him was Mr. Pease, President of the Board of Education. Shortly after, Mr. Pease announced in the House of Commons that he was considering names of members of an "Advisory Council on Industrial Research"; I learn from Mr. Henderson, who has succeeded Mr. Pease in the Education Department, that he is proceeding to the appointment of this Advisory Council.

Letters have appeared from time to time in the Press from fellows of the Royal Society and others urging the centralisation of scientific effort. Prof. Fleming, whose knowledge of wireless telegraphy is second to none, has had no opportunity of helping his country, although it is long since he offered his services; and Prof. Armstrong, on June 21, makes the reasonable assertion that no half-dozen persons have a right to assume that they can do all that is required in any branch of science, and reminds the public that had his suggestion been adopted that the Royal Society should have been grouped, according to subjects, into Grand Committees, we should have been many months in advance of our present position.

It has been necessary to survey what has been done

up to now, in order to consider what it is best to do. And I must repeat that the whole energy of every subject of our King must now—at once—be solely devoted to one object: that of helping our soldiers to defeat the enemy. Our Government has missed one great chance; if they had declared cotton contraband of war in January, as they were implored to do from many quarters, in all probability the war would be now nearing its end; the enemy would have run short of propulsive ammunition.

I may be allowed to quote a letter I have received from a distinguished French professor of chemistry, an adviser to the French War Office:—

"Le coton doit être prohibé au même titre que le cuivre. Il est aussi indispensable à la fabrication des munitions que ce métal et, avec les exigences actuelles de la balistique, il ne peut être remplacé par aucune autre matière première pour la fabrication du coton-poudre.

"J'ose maintenant esperer que votre flotte fera bonne garde et qu'elle ne laissera plus passer les nombreux chargements qui s'acheminent vers l'Allemagne par le voie de le Suède, du Danemark et surtout de la Hollande.

"Il est probable que si ces derniers pays avaient pratiqué une vraie neutralité, nous serions bien près de la fin des hostilités et n'aurions plus à déplorer des pertes journalières de milliers de vies humaines."

As it is, cotton is still freely entering Germany through Rotterdam; it is true that a Dutch syndicate is bound under a penalty of 10,000*l.* to exclude it, if delivered to them; but there is good reason to believe that this penalty is ineffective.

It is bad policy to regret what might have been; it is much better to try to devise plans to make up for lost time; and the first essential is organisation. It is notorious that there is little intercommunication between the various Government Departments; many of them are confronted by the same difficulties; many of these difficulties would be overcome if scientific advice were asked for; and the prime necessity at the present moment is a central body of scientific men, to whom the various Government Departments should be compelled to apply for advice and assistance. And more; it should be within the province of such a central organisation of science to propose new means of circumventing the enemy; it should have access to special information, and should be in close touch with all Departments of State, by having State officials as assessors at the meetings of the committees.

Instead of this centralisation, what do we see? Numerous small committees, composed of men who may be perfectly capable, but who are not in the public view; men whose mouths are muzzled, because it has been decided, in each case, to keep their names secret. This, I think, is due to a confusion of ideas; there is no object in preserving secrecy as to the members of such committees; there is every reason that they should regard their deliberations and actions as confidential.

Now, the creation of such small committees by various members of the Government has had the effect of stopping the organisation of men of science. Those who are serving on the committees feel that they would be guilty of a breach of trust were they to take part in the formation of a strong, central body of organised science. Hence various attempts to elicit the views of the fellows of the Royal and other societies have been blocked at the outset. What is the remedy? Let us see if we cannot learn from our neighbours the French; they have a remarkable power of meeting a difficult situation.

I have before me a document headed "République française. Ministère du Commerce, de l'Industrie, des Postes et Télégraphes. Office des Produits Chimiques et Pharmaceutiques." The *directeur* is one of the best-known French chemists, the discoverer of synthetic camphor and the inventor of a process for producing it commercially.

Various "Commissions," or, as we should say, Committees, have been appointed. These are:—(1) Commission on Patents. (2) Commission on Chemical Solvents, Alcohol, etc. (3) Future Commercial Situation of German Works in France. (4) Customs Commission; Customs Union of the Allies. (5) Transport Commission: Rail, River, and Canal, and on the High Seas.

Other special Commissions deal with colours, drugs, general chemical manufactures, including manures, and with synthetic and natural perfumes. These are all in active operation. Each will make a report which will go first before the General Commission, and afterwards their proposals will be brought before the Chambre des Députés—the French Parliament.

Just imagine the state of mind of the permanent officials of our Government Departments were such a scheme forced upon them! It would disturb the even tenor of their way; they would be obliged to do something, instead of carefully classifying all proposals made to them, and putting each into its appropriate pigeon-hole. But they have not yet realised that we are engaged in a war in which ancient practices may have to be superseded.

What are men of science to do? The Chemical Society has begun to organise itself; the Royal Society still hangs fire; other societies, I believe, have made attempts. It must be admitted that they have received scant encouragement. The recent deputation of some societies to Messrs. Runciman and Pease has resulted in the appointment of an Advisory Council of the Board of Education to encourage research. Various eminent men have been asked by Mr. Henderson, Mr. Pease's successor in office, to serve on this Council. It would appear that their functions will be chiefly to encourage education, especially in connection with research—a most excellent object, but surely one which can stand over until this life-and-death struggle is decided. I am glad to learn that it is not proposed to establish more scholarships; they tempt young men to embark on a scientific career for which there is little reward; for many of our manufacturers have not had time to grasp Lord Playfair's aphorism, now more than sixty years old—"It is only experience, aided by science, that is rapid in development, and certain in action."

It is never too late to try to mend; and it is clear that we need expect no initiative from members of our Government. But we might, as scientific men, organise ourselves; and then endeavour to induce the Coalition Government to take some such steps as were taken by the French Government on August 4.

I am much indebted to Lord Sydenham for permission to use a draft of a scheme, which he provided at my request, for the organisation of the Royal Society. It has not yet been submitted to that body, which stands at the head of all our other scientific societies, nor to other societies; but it is certain that each society, after organising itself, would be willing to place its organisation at the disposal of the oldest and premier scientific society of the world. His scheme is as follows:—

"The Royal Society keenly desires to place all its resources of expert knowledge and experience, collective and individual, at the disposal of his Majesty's Government, for the purposes of the war.

"It is also proposed to act as an intermediary between H.M. Government and other learned societies with a view to obtain their co-operation, which, it is certain, will be freely given.

"Already the Royal Society has formed committees

for dealing with certain branches of applied science which can be brought to bear upon the operations of war. It is necessary to regularise the position and to extend the sphere of influence of such bodies. In order to carry out these objects without delay, the following measures appear to be necessary:—

"(1) The Royal Society to be formally constituted as an advisory body in regard to scientific questions arising out of the war, and requiring to be dealt with by his Majesty's Government.

"(2) For this purpose the Royal Society would establish a general advisory committee to which all Departments of State would be directed to apply for assistance in regard to such matters as the following:—

"(*a*) New inventions or suggestions involving the application of science to warfare by sea or land.

"(*b*) Any problems arising out of the proved needs of war which call for scientific treatment and investigation.

"(*c*) Improved methods of manufacture, or new manufactures, requiring to be started.

"(3) The duties of the general advisory committee would be:—

"(*a*) To make such subcommittees as are needed to deal with all the above-mentioned matters.

"(*b*) To allocate them either to these subcommittees, or to individual experts, as may seem most efficacious.

"(*c*) To secure co-ordination and to prevent overlapping of work.

"(4) The general advisory committee should also be empowered to make suggestions to the head of any Department of State in regard to questions of applied science.

"(5) The subcommittees would not necessarily consist only of fellows of the Royal Society, but would contain members of other scientific societies, or individual experts, together with representatives, nominated by the Department of State concerned.

"(6) Such representatives would act as intermediaries between the subcommittee and the Department, and would obtain from the latter any information required.

"(7) If, arising out of the war, new processes of manufacture were needed to be begun, or existing processes to be improved or extended, the subcommittee involved would co-operate with the Munitions Department, and would provide such expert knowledge as might be required.

"(8) When special experiments, lying beyond the resources at the disposal of, or accessible to, the Royal Society, became necessary, funds should be made available *ad hoc*, either by the Treasury, or by the Department concerned."

It will be observed that Lord Sydenham's draft scheme deals only with exigencies of war. But is it too much to hope that if and when peace comes, the organisation would not be allowed to lapse? This will not be the last war; we have learned, in the crucible of fire, that we must be prepared. Nor is what we usually term "war" what is most to be dreaded. It is the insidious advance by fair means or foul means of our enemies the Germans to obtain a monopoly of all fields of human endeavour. That nation is organised for that purpose, and this war is merely one attempt, and let us hope a fruitless attempt, to obtain world-wide dominion.

May I conclude by quoting again from Sir Norman Lockyer's presidential address?

"Without such a machinery [as that of a Scientific National Council], how can our Ministers and our rulers be kept completely informed on a thousand things of vital importance? Why should our position and requirements as an industrial and thinking nation receive less attention from the authorities than the head-dress of the Guards? How, in the words of Lord Curzon, can 'the life and vigour of a nation be summed up before the world in the person of its Sovereign' if the national organisation is so defective that it has no means of keeping the head of the State informed on things touching the most vital and lasting interests of the country?"

In the course of his remarks while moving a vote of thanks to Sir William Ramsay for his address, the president said:—Though some of us may differ from Sir William as to the likelihood of another war as great as this, on one point we are all bound to agree with him, namely, that there should be prompt national organisation of all the scientific capacity we possess; co-ordination, and supreme control by a council—it need not consist of more than a dozen men, whose duty it should be to apply scientific results to the war in every department. There is no doubt in the world that we can have an organisation in Great Britain equal to anything which the Germans possess if we will only make up our minds to do it. Our Parliamentary Committees and other committees dealing with most important aspects of this war will not succeed in doing anything of real importance to our present needs unless they work through such a council as has been suggested. From that point of view I think the British Science Guild might be of service. We must spare no effort to impress upon the Government and the public that the course proposed by Sir William should be taken at once.

Sir Archibald Geikie, in seconding the vote of thanks, said:—It is a painful history—the history of the indifference of the State to science and our country. I throw my mind back to the time when I heard Sir Lyon Playfair give that address from which Sir William has quoted, and I know that every word then said was true. I dare say that since that time some of the indifference—I would almost call it the antipathy—on the part of the official mind towards science has altered a little for the better, but there is still plenty to be done. It is not all the fault of Governments. They themselves have to work against the dead-weight of this incubus of indifference which goes right through society. The Royal Society has been mentioned, and I am proud of its history. As you are aware, the Royal Society is actively at work at present, the council having been converted into a war committee so as to devote the whole of its efforts to war matters. If there is to be some central committee dealing with scientific matters, I am sure there could be no more efficient centre than the council of the Royal Society.

The proceedings terminated with a vote of thanks to the chairman, proposed by Sir Ronald Ross, seconded by Sir A. Phillips, and carried unanimously.

A CONSULTATIVE COUNCIL IN CHEMISTRY.

WE print below a letter issued by the president and council of the Chemical Society with the view of assisting the Government to bring the war to a successful conclusion. Fellows of the society are invited to offer suggestions likely to be of value to our armed forces, to state in what branch of work they consider they can be of most use to the country at the present juncture, and what facilities they can offer either as regards laboratory accommodation or time available for voluntary work on national services. The council has constituted itself a consultative committee to consider suggestions and inventions placed before it; and its action should be the means of placing at the disposal of the country an effective body of expert opinion. The co-ordination and organisation of the various branches of chemical science and their appli-

cation are of the utmost importance to the Empire; and the efforts being made by the Chemical Society with these ends in view will give satisfaction to all who realise the difficulty of the problems before us.

Whilst much has been done to assist the Government in many of the scientific problems arising from the war, the technical knowledge and talent of the nation are not being utilised to their utmost. No one knows what is being done, and there is no way of finding out what problems in chemistry, physics, and engineering are urgently requiring solution. The practical man with his problem has no means of getting in touch with the inventor who delights in grappling with practical difficulties, or with the man of science who can bring his expert knowledge to bear upon it. Further, it is realised that an overworked War Office is not the place at which original methods or devices can be given adequate and competent consideration.

In order to remedy this unsatisfactory condition of affairs some system for organising and co-ordinating the inventive power of the country must be devised. With the object of doing this for chemistry and its allied sciences, the Chemical Society has put forward its scheme. The society will have the co-operation of committees specially qualified to deal with individual problems; each of these committees will consist of eight members, of whom six will be appointed by one of the kindred societies, while the other two will be members of the council of the Chemical Society, to form a link with it as the central body which will forward inventions or suggestions and the reports upon them to the proper authority. For dealing with questions of the general policy to be pursued, both during and after the war, a committee thoroughly representative of chemical opinion in all its branches will, we understand, be appointed immediately.

The Chemical Society,
Burlington House, Piccadilly,
London, W.

DEAR SIR,—In March last the Council of the Chemical Society presented to the Prime Minister a memorial on "The Position of the Chemical Industries" in this country and asked him to receive a deputation from the Society to explain in greater detail the opinions set forth therein. A similar memorial had also been presented by the Royal Society, and on May 6th the Presidents of the Boards of Trade and Education received a joint deputation from the two societies. The deputation[1] assured his Majesty's Ministers of the loyal desire of the Fellows of both Societies to assist the Government and promised their hearty co-operation in all that could be done to utilise the great but latent chemical talent of the nation.

As the war proceeds, the paramount part which chemical science is playing and is destined to play in the present struggle becomes daily more evident to everyone, and in pursuance of the assurance given to the President of the Board of Trade, the Council has constituted itself a Consultative Body which will meet at frequent intervals to consider, organise, and utilise all suggestions and inventions which may be communicated to it, and will report on the same to the proper authorities. In this work it will have the assistance of Committees specially qualified to deal with individual problems, the nature of which will doubtless be very diverse. The Council is of opinion that much can be done in this way to relieve the overwrought Government Departments of work which would probably appear less complex to such Committees of chemical experts.

[1] A report of the proceedings will appear in the Transactions for July.

This Consultative Body having now been formed, the President and Council invite the Fellows of their own and kindred societies to forward *in strict confidence* suggestions and inventions for its careful consideration. However trivial some of these suggestions may appear if taken alone, it is always possible that when brought into correlation with others they may lead to results of great value, and it is this process of correlation and subsequent presentation to the suitable Government authorities which the Council has in view.

All suggestions should be addressed to the Council of the Chemical Society, Burlington House, London, W., and will be regarded as confidential by the Council, which feels that it may rely on the loyal and energetic co-operation of the Fellows in this attempt to render assistance to the Empire.

It is of great importance that the Council should know on whom it can rely for help and the nature of the services each Fellow can render; it will be of considerable assistance, therefore, if you will kindly fill in and return the form attached.

Issued by the authority of the Council,
ALEXANDER SCOTT,
President.

July 1, 1915.

THE RESEARCH DEFENCE SOCIETY.

HAPPY are those scientific societies which have not been thrown out of work by the War, but have found something that they can do for the country in its time of suffering. The Research Defence Society, if its only occupation were to denounce and oppose anti-vivisection, would have been well-nigh useless since last August; none of us, now, is thinking of this old adversary of science. But the Research Defence Society found plenty of work; it set itself to the business of explaining and commending, to audiences of soldiers, the protective treatment against typhoid fever, and, at its annual general meeting on June 30, it was able to give a good report of this part of its work.

Last October, with the approval of the War Office, it published a four-page leaflet, "Protection Against Typhoid Fever." Consignments of this leaflet were sent, with the help of the War Office, to be distributed through the Army. Many scientific or philanthropic bodies also helped in the work of distribution. About 350,000 copies of this leaflet have already been issued. It has been translated into French, and 20,000 copies of this translation have been distributed, by the help of M. Maton, Belgian Military Attaché in England. Copies of the leaflet can be had on application to the hon. secretary of the society, 21 Ladbroke Square, London, W. The society also has given a great many lectures to soldiers, illustrated with lantern-slides and moving pictures, on wound infection and on the infective diseases, with special reference to the protective treatment against typhoid fever.

The opposition to this treatment, happily, is nearly over. It would not stand against the facts of the case, and there is an end of the matter. Mr. Tennant, in the House of Commons, on July 1, gave the latest figures relating to it, and they leave nothing to be said. But there is another disease, tetanus, which has been fought, and beaten, among the Expeditionary Force, by a protective treatment. None of us can soon forget the terror of the news, early in the war, that tetanus was frequently occurring. We feared lest it should be again as dreadful as it was in the American Civil War. Everything was in its favour: the soil was heavily charged with tetanus-germs, many of the wounds were deeply lacerated, and the vast majority of them were septic. It is impossible to

doubt that the protective use of tetanus antitoxin is the principal cause of the disappearance of tetanus among our wounded; there are but very few cases of it now. Sir William Osler, at the annual meeting of the Research Defence Society on June 30, rightly emphasised this point; it does not need to be emphasised for those of our readers who are medical men and have watched cases of tetanus.

After the meeting Dr. Andrew Balfour gave a demonstration of the protective treatment against typhoid, showing, with admirable ingenuity, how completely the resistance of the body to invading germs may be described in terms of human warfare. Not all men of science are skilful in the use of parables, but he is.

Some day, those of us who live long enough will be able to read the medical and surgical history of the present war. It has been taken in hand by many writers of authority, and it will be fine reading. It will interpret to us one of the noblest records of science in practice. Interpreters of science, popularisers of science, are always useful, and the Research Defence Society has certainly done useful work by interpreting and popularising the methods and the achievements of modern physiology and pathology.

FERROMAGNETISM AND THE A2 TRANSFORMATION IN IRON.

RECENT years have witnessed a remarkable concentration of experimental research on the critical point A2 in iron. Moreover, whereas up to the year 1904 investigations of this character were carried out chiefly by metallurgists and engineers, since that date there has been a most welcome entry of physicists and physical chemists into this field of research, who in virtue of their different training and outlook have investigated the problem from a somewhat different point of view, and, it must be granted, by more rigorously scientific methods. The paper by Mr. Kotaro Honda, of the Imperial Tohoku University, Japan, on the nature of the A2 transformation in iron, presented at the spring meeting of the Iron and Steel Institute in London, is a valuable contribution by a physicist who has made a special study of this question for a number of years.

Broadly speaking, there are three views of the nature of the A2 transformation which the author summarises in the following language:—

"(1) The transformation is an allotropic change (α to β) occurring at a definite temperature, or at least within a small range of temperature; (2) β-iron is not an independent phase but a solid solution of α and γ iron; (3) the transformation is not an allotropic change but an intermolecular change taking place in the α phase within a considerable range of temperature."

The first view is historically the oldest, and is particularly identified with the late M. Osmond. It was warmly adopted by Roberts-Austen and his co-workers, and is apparently still supported by Tammann, Howe, Sauveur, Burgess, and Rosenhain, although it raises several difficulties in explaining the facts actually observed. The second view was enunciated in 1912 by Benedicks, but although at first sight a promising case was made out, and it appeared to be supported by a test research published by Carpenter in 1913, it is in conflict with many well-established facts, and has been practically abandoned. The view that A2 is not an allotropic or phase change was first put forward by H. Le Chatelier, and shortly afterwards by P. Weiss. It numbers among its additional supporters at the present time Benedicks, Hadfield, Carpenter, Edwards, McCance, and Honda. It is the most modern view of the nature of the transformation.

Mr. Honda's experimental contributions to the study of the nature of the A2 critical point as revealed in his paper relate to (1) the thermal changes associated with the transformation; (2) magnetisation at high temperatures; and (3) magnetic expansions at high temperatures. With respect to the first-named they confirm what has long been known, viz., that the heat evolution on cooling, and heat absorption on heating corresponding to the A2 transformation take place over a wide range of temperature, at least 100° C., although the greater part is evolved or absorbed within 30–40° C. The complete range, however, is probably considerably more than 100° C. A transformation extending over so wide an interval cannot properly be regarded as an instance of "one-phase allotropy." Neither is it correct to speak as Burgess and Crowe do of the temperature at which $dq/d\theta$ is a maximum, as the critical point or range. The author regards the temperature at which the heat evolution begins on cooling, or the heat absorption ends on heating, as the critical point, and uses the expression in this sense. It is also the temperature at which ferromagnetic iron becomes paramagnetic, or *vice versâ*.

The most important section of Honda's paper is that dealing with magnetisation at high temperatures. Many metallurgists hold the view that the magnetisation of ferromagnetic metals undergoes an abrupt change at their critical points, but this is seldom the case. In fact, the course of the temperature-magnetisation curves changes markedly with changes of strength in the magnetising field, and Honda's experiments on pure iron, nickel, and various kinds of steels show this clearly. In a very weak field the magnetisation of iron and nickel increases with temperature at first slowly, and then very rapidly, and after reaching a sharp maximum it falls extremely quickly at the critical temperature. If the strength of the magnetising field is augmented this effect of increasing magnetisation becomes continually less. In a field of several gauss the magnetisation remains constant up to the critical point and then falls very rapidly. With further increase of field the magnetisation begins gradually to decrease from a temperature which is lower as the field is stronger, and in a field of several hundreds the magnetisation begins gradually to decrease from the room temperature. In all cases the effect of temperature on magnetisation is twofold, and the observed change of magnetisation is the sum of these two effects. The first effect is specially conspicuous in weak fields, and becomes continually less as the field is increased. It is similar to the well-known mechanical tapping on magnetisation, which it increases, the thermal agitation playing the part of mechanical shocks. The second is a reversible effect, and always acts in diminishing magnetisation. By incessant thermal impacts the molecular magnets execute rotational vibrations about their mean orientations, and the mean magnetic effect is diminished by the vibration. It is easy to see therefore that the decrease of magnetisation increases with the amplitude of rotational vibration—*i.e.* with rise of temperature. In very strong fields the first effect no longer obtains and there exists chiefly the second reversible effect of temperature.

Mr. Honda has concerned himself only with the latter, which is much the more important of the two. With respect to iron, his conclusion is as follows:—"In strong fields when the irreversible thermal effect is negligible the magnetisation begins to diminish from the lowest temperature, the change per degree of temperature increasing at first gradually but becoming always greater as the critical temperature is approached. If the change of magnetisation indicates that an intermolecular change is taking place in the substance which at the same time manifests itself

as the evolution or absorption of heat, then the two quantities q and I must vary parallel to each other. Strictly speaking, therefore, the heat should begin to be absorbed from the lowest temperature in the case of heating, though its amount is negligibly small, except in the A_2 range."

Mr. Honda also tested the question whether the magnetic and thermal changes are really different aspects of one and the same transformation taking place in the substance. This was done by making simultaneous observations of the magnetisation and the heat evolutions or absorptions in the critical range. Both for iron and nickel it was found that the temperature of the beginning of the magnetic "transformation" on cooling, and that of its ending on heating, coincide well with the corresponding temperatures of heat evolution and absorption respectively. In other words, the critical temperature as determined magnetically agrees with that as determined thermally.

The final section of the paper contains a summary of the author's theory of ferromagnetism, according to which the shape of the molecules of a ferromagnetic substance is nearly spherical, whereas in a paramagnetic substance the molecule has an elongated or flattened form. The transformation of a ferromagnetic to a paramagnetic substance at high temperatures is explained as a consequence of the gradual deformation of the spherical molecules with rise of temperature. The paper is one which should certainly be studied by those who are interested in the A_2 transformation, not only in pure iron but also in steels.

H. C. H. C.

RECENT MARINE RESEARCHES.

THE report of the Danish Biological Station for 1914 contains two papers describing investigations which have been carried out at the station with a view of determining the importance of the detritus derived from the decay of Zostera and other sea-weeds as a source of food for the invertebrate bottom fauna in Danish waters. The idea was recently put forward by Dr. C. G. Joh. Petersen that in these waters this organic detritus is of much greater importance than the plankton. P. Boysen Jensen, in a paper entitled "Studies concerning the Organic Matter of the Sea Bottom," deals with the question from a chemical point of view. By determination of the quantity of pentosan in proportion to the amount of organic matter it was found that Zostera was relatively far richer in pentosan compounds than the plankton organisms. The organic matter of the sea bottom occupied an intermediate position. The author concludes that in the more sheltered waters the organic matter of the sea bottom is almost exclusively derived from Zostera, whilst in more open waters plankton organisms are possibly of some importance.

The second paper is by cand. mag. H. Blegvad, on food and conditions of nourishment among the communities of invertebrate animals found on or in the sea bottom in Danish waters. The stomach contents of a great many animals from different localities have been studied, but unfortunately the discussion of the observations is somewhat illogical and unbalanced, so much so that it is difficult to avoid the fear that a certain amount of unconscious bias may even have crept into the observations on which the discussion is based. The author summarises his conclusions as follows:—"Detritus forms the principal food of nearly all the invertebrate animals of the sea bottom, next in order of importance being plant food from fresh benthos plants. The value of the living phytoplankton in this connection is absolutely minimal, amounting in any case to nothing more than an indirect significance through the medium of the plankton copepods."

A distinct advance in the study of the question of the determination of the age of fishes by the markings on the scales has been made by O. Winge in a paper on the value of the rings in the scales of the cod as a means of age determination, illustrated by marking experiments (*Meddelelser fra Kommissionen for Havundersögelser*, ser. Fiskeri, Bd. iv., No. 8). The work is based chiefly on material obtained from cod which were marked and liberated by Dr. Johs. Schmidt in the neighbourhood of the Faroes and of Iceland. Samples of the scales were taken before the cod were liberated, and again on their recapture, and the two have been compared. Considerably more than half the cod marked were recaptured, some of them after an interval of a year or more. A novel and very convincing method of recording the results of the examination of the scales has been used. The lengths of the individual sclerites on a line from the centre to the periphery of the scale have been measured, and the measurements recorded in the form of curves. These curves bring out with great clearness the difference between the summer and winter growth. The otoliths of the fish have also been studied, and the author finds that a very high degree of uniformity exists between the growth of the scales and that of the otoliths, both exhibiting growth rings by which the age of the cod can be determined.

In a paper entitled "The Salinity and Temperature of the Irish Channel and the Waters South of Ireland" (Fisheries, Ireland, Scientific Investigations, 1913, vol. iv. [1914]) Mr. Donald J. Matthews gives an account of the hydrographical investigations which were carried out by the Irish Fisheries Department between February, 1903, and May, 1912. The results are based chiefly on observations made on quarterly cruises, which took place in February, May, August, and November, supplemented by temperature records and salinities obtained at more frequent intervals from lightships. An excellent series of charts and sections is given setting forth the mean surface and bottom temperatures, and salinities for each of the months February, May, August, and November, and for the whole year. The saltest water enters the Irish area between Land's End and the Scilly Islands, and this current of salt, warm water is derived from a current which has already entered the English Channel from a south-westerly direction. This salt, warm current gives rise to a peculiar cyclonic circulation in the southern entrance of the Irish Channel, which may prove to be of considerable biological importance. The author considers it possible that a layer of high salinity water, traces of which are met with off the south-west of Ireland, may be connected with the salt intermediate layer which flows out of the Mediterranean into the Atlantic, and has previously been found far to the northwards of the Straits of Gibraltar. A salinity maximum which occurs off the south-west of Ireland in May is perhaps due to this Mediterranean water. The paper concludes with a discussion of the annual temperature changes in deep water.

THE FIFTIETH ANNIVERSARY OF THE WORCESTER POLYTECHNIC INSTITUTE, MASS.

THE Worcester Polytechnic Institute celebrated the fiftieth anniversary of its foundation on June 9, its charter having been signed on May 9, 1865, by John A. Andrew, the war governor of Massachusetts. There were present representatives from eighty universities and colleges, as well as invited guests eminent as statesmen, soldiers, and engineers. The dominant note of the occasion was not so much that of rejoicing over the half-century of progress or that of greater enthusiasm for training in efficiency, but rather that

of consecration to the task of training young engineers for their highest service to mankind and to the country.

The institute owes its origin to a gift of 100,000 dollars from John Boynton, supplemented by another gift of 50,000 dollars from Ichabod Washburn. The fundamental idea of the latter was a commercial shop in which students should find laboratory practice in connection with the academic training necessary to make of them engineers and chemists. As Mr. Boynton said, "The benefits of the school are not to be confined to the theories of science, but as far as possible they shall extend to the practical application of its principles in the affairs of life." The shop was regarded as an experiment, but it has turned out to be successful, both as an educational department of a college, and as a successful commercial venture. At first, the opinion was widespread that the school would become a place for educating mechanics and foremen, on account of a peculiar apprenticeship system that prevailed in the early years. It has developed into a professional school for applied science, giving the degrees in engineering and in chemistry. The shop has taken its place as a natural and practical laboratory within a college, exactly as the clinic or hospital may be associated with the medical school. Its organisation is permanent, and it would remain as a manufacturing establishment if every student left the school. The students therefore do not take an essential part in manufacturing, but they use a large part of the shop as their laboratory in the science of manufacturing. The term "scientific management" is vague, but the essential parts of that management which teaches a young man all of the elements, including the actual work, the organisation, the accounting, and the cost systems, are found in the Washburn shops.

The addresses of the celebration laid especial emphasis on the higher education of men for applied science, using the Worcester Polytechnic Institute as a good example of what may be accomplished in that direction. The speakers on June 9 were Mr. A. Lawrence Lowell, president of Harvard University; Dr. John A. Brashear, president of the American Society of Mechanical Engineers; Hon. David I. Walsh, governor of the State of Massachusetts; Hon. John H. Weeks, Senator for Massachusetts; Howard Elliott, president of the New York and New Hampshire Railways; Major-General Leonard Wood, former chief of staff of the United States Army; Ira N. Hollis, president of the Worcester Polytechnic Institute, and others.

President Lowell's address was significant in the text of his subject. "The thing that abolished slavery," he declared, "was not so much the change in morals as it was the change in the control of the forces of nature, without which the change in morals could not have taken place. This enlarged control of the forces of nature is what has made it possible for us to live in modern civilisation. The threatened exhaustion of natural resources and the gigantic destruction of human life and of wealth in the world conflict presents a challenge as to whether we have intelligence enough to prevent the serious set-back to civilisation that may follow. In meeting this challenge, large trustworthiness must be placed upon the schools of applied science."

General Wood's speech related almost wholly to the establishment and maintenance of a citizen soldiery behind a small regular army in the United States. He commended the example of Switzerland as a country effectively prepared against war, securing a maximum of defence while avoiding a great military burden, the diversion of the people from their ordinary business, and the sacrifice of their ideals of democracy.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—The following honorary degrees were conferred at a Congregation held on July 3:—*Doctor of Laws*: Dr. David Forsyth, headmaster of the Leeds Central High School. *Doctor of Science*: Mr. Harold W. T. Wager, F.R.S., one of H.M. Inspectors of Schools, who began his professorial career at the Yorkshire College, and is distinguished by his researches in cytology and other biological fields. *Master of Science*: Mr. T. H. Nelson, of Redcar, a distinguished ornithologist, author of "The Birds of Yorkshire"; Mr. W. Denison Roebuck, joint author of "Handbook of the Vertebrate Fauna of Yorkshire"; Mr. T. Sheppard, curator of the Hull Museums, author of "Geological Rambles in East Yorkshire," "The Lost Towns of the Yorkshire Coast," and many geological and archæological memoirs; Mr. J. W. Taylor, author of a "Monograph of the British Land and Freshwater Mollusca"; Mr. J. G. Wilkinson, past-president of the Leeds Naturalists' Club, distinguished by his extensive and exact knowledge of the structure of plants, though blind; Dr. T. W. Woodhead, lecturer in biology at the Technical College, Huddersfield, hon. secretary of the Yorkshire Naturalists' Union, and author of various biological memoirs.

OXFORD.—The Halley lecturer for the year 1916 is Prince Boris Galitzin, professor of physics in the Imperial Academy of Sciences, Petrograd. The subject of the discourse is not yet announced.

It will be remembered that at the time of the appointment of the present Waynflete professor of chemistry, Prof. W. H. Perkin, F.R.S., the University decided on the erection of a new chemical laboratory. The building, designed by Mr. P. Waterhouse, is now nearly finished. It occupies a site in the south-west angle of the Parks, close to the University Museum, and has a frontage in South Parks Road. The expense of the actual building was largely provided by the Endowment Fund presided over by Lord Curzon, as Chancellor of the University, and also by a timely and generous donation of 5000*l.* from Mr. C. W. Dyson Perrins, formerly of Queen's College. But Mr. Perrins's munificence has not stopped here. He has lately offered to present to the University a further sum of 25,000*l.*, of which 5000*l.* is to be applied to the equipment of the laboratory, and the remaining 20,000*l.* is to form a permanent endowment fund for maintenance of the laboratory and for the encouragement of research and instruction in chemistry. The University is thus relieved from anxiety about the upkeep of the department—a matter which is frequently lost sight of by benefactors. There is now every prospect that the new laboratory will open in October next under the happiest auspices, and that the wise provision made by Mr. Perrins for research will bear ample fruit in the future.

BY the will of the late Alderman Owen Ridley, University College, Reading, receives 1000*l.* for the building or equipment of new college premises, 250*l.* for the assistance of necessitous students, and 200*l.* for prizes for evening class students.

WITH the issue of the *Athenæum* for July 3 is published the first instalment of a Subject Index to Periodicals, which our contemporary is undertaking at the request of a committee appointed for the purpose by the Library Association. To begin with, the progress of science and technology in 1915, with special reference to the war, is being indexed. We welcome this attempt to provide a much wanted guide to current literature, and trust that with competent scien-

tific assistance a comprehensive and representative index will shortly be forthcoming.

AT the last meeting of the council of the University College of Wales at Aberystwyth it was announced that Mr. S. G. Rudler has founded a scholarship in memory of his brother, the late Mr. F. W. Rudler, who was professor at the college from 1875 to 1879, before taking up his work at the Royal School of Mines. Mr. Rudler has also allowed the college to acquire at a small cost the collection of scientific instruments, minerals, fossils, gems, and curiosities, and the library formed by his brother during a period of fifty years. The library includes not only standard works on geology, but also a collection of 3000 pamphlets on geological and kindred subjects.

THE issue of *Science* for June 18 announces the following gifts to American colleges. Two anonymous gifts of 30,000*l.* and 20,000*l.* to the Massachusetts Institute of Technology for dormitories; for funds to construct the mining building some 45,000*l.* has been offered by Messrs. C. Hayden, T. Coleman du Pont, and S. Pierre du Pont, past and present presidents of the du Pont de Nemours Powder Co. Mr. Coleman du Pont, with a gift of 100,000*l.*, made the purchase of the technology site in Cambridge possible. Messrs. C. A. Stone and E. S. Webster have undertaken to provide a residence for the president. Mr. J. R. Lindgren, of Chicago, has bequeathed half his estate, valued at 210,000*l.*, to Northwestern University, subject to certain life annuities. From the same source we learn that the sum of 6000*l.* has been given to Dalhousie University, Halifax, N.S., towards the endowment of a chair of anatomy, and it is stated that in the near future the sum will be doubled.

THE Calendar for the Imperial University of Tokyo is instructive reading, tracing as it does the development of a highly organised University where scientific research lives and thrives from what was, a generation ago, little more than a high-class school. There are six colleges—law, medicine, engineering, literature, science, agriculture—with a staff of professors, assistant-professors, and lecturers numbering close on 400, who teach and train some 1500 students. Barely 5 per cent. of these are students of science, while the law students number nearly 40 per cent. of the whole. Some idea of the specialisation attained may be gained from the statements that there are twenty-six professorial chairs to about seventy students in the College of Science, and that of these there are four chairs in mathematics, three in physics, two in theoretical physics, four in chemistry, three in zoology, three in botany, two in geology, and one each in mineralogy, geography, seismology, and anthropology. The journal of the college, which began publication in the year 1887, has now reached its thirty-fifth volume, and contains many important memoirs, chiefly in English, on all branches of pure science, contributed for the most part by the Japanese themselves. With the exception of the Law College, all the other colleges also publish memoirs or bulletins. This is a remarkable record, and shows that the ideal aimed at is being successfully maintained.

SOCIETIES AND ACADEMIES.

LONDON.

Challenger Society, June 30.—Dr. G. H. Fowler in the chair.—C. Tate **Regan**: The fishes of the Macquarie Islands. Attention was directed to the importance of these little-known islands from a faunistic point of view, lying as they do near the boundary between the Antarctic and Subantarctic zones.—Dr. W. T. **Calman**: The distribution of Antarctic Pycnogonida. This paper was based on a study of the collections obtained by the British Antarctic (*Terra Nova*) Expedition, 1910. No fewer than forty-three species were obtained, of which eleven will be described as new. These results accentuate the remarkable richness of the Antarctic Pycnogonidan fauna and its preponderance over that of the Arctic seas, regarded until recently as the headquarters of the group. Only a few species have been definitely proved to have a circumpolar distribution, but it is certain that the number will be greatly increased by further collecting, although some cases of more restricted range (*e.g.* the species of Decolopoda) are already known. The isolation of the fauna is shown by the fact that not more than two or three species are definitely known to extend, in shallow water, into the Subantarctic zone.

DUBLIN.

Royal Dublin Society, June 22.—Prof. W. Brown in the chair.—W. D. **Haigh**: A method for the estimation of hygroscopic moisture in soils. In the ordinary method of determining the hygroscopic moisture in soils difficulties occur from the fact that other vapours besides hygroscopic water may be given off by the soil when heated. The power of calcium carbide to act as a desiccating agent has of recent years been put to practical use. It has been applied to the determination of moisture in wool, explosives, etc. Calcium carbide possesses the advantage that the only ordinary substance which will react with it is water, and the acetylene evolved can be readily measured. The method consists of mixing the soil with an excess of finely powdered calcium carbide. The reaction is complete in a few minutes, and the volume of acetylene is measured in a nitrometer over mercury. It has been found that the results obtained are consistent and agree fairly closely with those obtained by heating in the oven; but in an ordinary soil the carbide determination is generally from 0·1 per cent. to 0·3 per cent. lower than that obtained in the oven. This has been found to be due to the presence of volatile material other than water vapour in the soil, such material being included in the reckoning with the hygroscopic moisture in the ordinary method of determination.—Dr. J. H. **Pollok**: The presence of bromine in the salt lagoon at Larnaca, Cyprus. The lagoon is about three square miles in area and is situated about one mile from the port of Larnaca, on the southern shore of the island. In the winter the lagoon fills either by infiltration or otherwise, and during the hot months of summer evaporates almost to dryness, leaving a deposit of excellent salt, from which the Government derives a considerable revenue. At the time of greatest concentration, towards the end of August, there is a pool of mother liquor in the centre of the lagoon, having a width of 1800 ft., a length of about 3600 ft., and an average depth of about 3 in., giving an aggregate of about 60,000 cubic yards, or, say, 40,000 tons of liquor. The latter was found on examination to consist of an almost saturated solution of magnesium chloride, together with a small proportion of magnesium bromide. On estimation the liquor gave 5·7 grams of bromine per litre, which is equivalent to about 10 lb. weight per ton. Owing to the war there is at present a very serious deficiency in bromides, and even in magnesium salts, the supplies of which have hitherto been largely derived from Stassfurt, Saxony. The new supply from Cyprus should go a long way to diminish the present shortage.

EDINBURGH.

Royal Society, June 7.—Sir T. R. Fraser, vice-president, in the chair.—Prof. Cossar **Ewart**: Development of the horse during the third week. Much progress had been made during the last fifty years in working

out the pedigree of the horse from the fossil remains of its ancestors; but with the exception of the attempt made by Hausmann in Hanover some eighty years ago no systematic study had been made of the development of the living horse. As early as 1876 it had occurred to Huxley that strong evidence of the fact of evolution would be forthcoming if it were proved that the modern horse passed through a hiparion or three-toed stage during development. He failed in his search, not because it did not exist, but because it appeared much earlier than he had expected. Later Bonnet and Martin had both described embryos which were believed to represent the stage reached at the end of the third week; and Bonnet concluded that a twenty-one days' plastocyst might vary from 13 to 35 mm. in length. An exhaustive inquiry had led Prof. Ewart to the conclusion that Bonnet's 13 mm. plastocyst represented the stage reached on the fourteenth or fifteenth day of gestation, that the age of Martin's plastocyst was seventeen or eighteen days, and that a twenty-one days' plastocyst measured not less than 50 mm., or 2 in. These conclusions were supported by some of Hausmann's figures. Many other details were given of the developmental changes which took place during the third week, the peculiarities in the Equidæ being accentuated by comparison with sheep embryos at like periods in the life-history. A magnified model which had been reconstructed by Dr. A. Gibson from Prof. Ewart's sections was exhibited and described by Prof. Robinson.—Prof. **Whittaker**: The functions which are represented by the expansions of the interpolation theory. It is well known that there is an indefinite number of functions the values of which at points at finite intervals are the same as those of a given function. These being called *cotabular functions*, it is shown that there is a certain function belonging to the cotabular set which is represented by a well-known expansion in the interpolation theory. This function is called the *cardinal function*. Its properties are investigated, and a formula is given by which it may be constructed when any one function of the cotabular set is known.—Prof. A. E. **Letts** and Miss Florence W. **Rea**: A modification of Pelouze's method of determining nitrates.—Frank L. **Hitchcock**: Quaternion investigation of the commutative law for homogeneous strains. It has long been known that strains with three different roots are commutative only when the directional roots in the one are parallel to those in the other. When two roots are equal the law of commutation is not the same. Various cases were classified.

PARIS.

Academy of Sciences, June 28.—M. Ed. Perrier in the chair.—J. **Boussinesq**: The drawbacks of Fourier's solution in a trigonometric series for the calculation of the cooling of the earth's crust; and other methods of carrying out this calculation.—C. **Guichard**: The W congruences belonging to a complex of the second order. Case where the equation in S has a double root.—D. **Eginitis**: Observations of the Mellish comet made at the Observatory of Athens with the Doridis equatorial. Positions are given for May 5, 10, 11, 12, 14, 15, 19, and 20.—Maurice **Fréchet**: The definition of an integral extended to an abstract ensemble. An extension of Radon's definition of an integral.—L. **Tschugaeff** and N. **Wladimiroff**: A new series of compounds of tetravalent platinum. The chloride of the base $(Pt.5NH_3Cl)(OH)_3$, or $(Pt.5NH_3Cl)Cl_3$, has been prepared by the action of liquid ammonia upon ammonium chloroplatinate at the ordinary temperature. The carbonate and sulphate of the new base are nearly insoluble in water, and only three atoms of chlorine are removed by silver nitrate in boiling solutions.—Fernand **Camus**: The mosses found in the stomach of a mammoth.—Artatnet de **Vevey**: Sun cures. An account of the diseases cured or ameliorated by sun treatment. The method proposed by the author has been used in the neighbourhood of Paris for twelve years. G. **Tizzoni** and P. **Perrucci**: Determination of the immunising and curative value of antitetanic serum. It is pointed out that there is a complete parallelism between the protective action of an antitetanic serum and its curative effect for tetanus: these two properties of a serum are not parallel with the antitoxic power *in vitro* of the same serum. From the physiological point of view it is probable that the mechanism of the action of antitetanic serum upon strychnine is identical with its action upon tetanotoxin. A method is proposed and given in detail for utilising strychnine for the standardisation of commercial preparations of tetanus antitoxin. F. **Bordas** and S. **Bruère**: Contribution to the study of the phenomena of putrefaction. A suggestion for the use of appropriate ferments for hastening the decomposition of dead bodies.

CALCUTTA.

Asiatic Society of Bengal, June 2.—H. C. **Das-Gupta**: Palæontological notes from Hazara. The author has described a few fossils obtained from the Triassic, Jurassic, and Tertiary beds of Hazara, and these fossils include one new species of Corbula (*C. middlemissi*) and another new species of Nautilus (*N. hazaraenois*).—Bimala Charan **Batabyal**: Dakshindar, a godling of the Sunderbuns. Dakshin Rai is a sylvan godling extensively worshipped in the districts in the neighbourhood of the Sunderbuns to scare away tigers. The procedure in his worship is the same as that of Ganapati. It seems to be a relic of aboriginal rites incorporated at a later period into Hinduism. A description of the idol is given with photographs.—Sarat Chandra **Mittra**: North Indian folk medicine for hydrophobia and scorpion sting. The author describes several charms and nostrums employed by the village *ojhas* or medicine men of northern India for the cure of hydrophobia and scorpion sting. He also publishes the texts, with translations and remarks, of two verbal charms for curing hydrophobia and one for exorcising the venom of scorpion sting.—Dr. B. L. **Chaudhuri**: The weighing beam called *Bisá dángá* in Orissa, with short notes on some weights and measures still current among the rural population of that division. The present paper gives a short description of two beams of the "bismer" type from Ganjam, where this kind of weighing beam is still in extensive use, and is known by the name of *Bisá dángá*, a name strangely similar to the Scandinavian. Two other weighing beams of the same type from the collection of the Indian Museum are also described in the paper, and the probable meaning of the name *Bisá* is discussed.—J. **Hornell**: The recent pearl fishery in Palk Bay with biological notes upon pearl oysters. The acquisition, from the Rajah of Ramnad, of his fishing rights on the Indian side of Palk Bay has permitted of the commencement of a systematic survey of the sea bottom of this region. The existence of two beds of pearl oysters was proved, the oysters being confined to an area of a bed of muddy sand between the $5\frac{1}{2}$ and $5\frac{7}{8}$ fathom contours, and associated sedentary species being few in number. A conservative estimate makes the number of oysters on this bed approximately twenty millions. The oysters from the larger—the Tondi—bed were numerically deficient in pearls, but a small number of pearls were exceptionally large and often of fine quality; the oysters from the smaller—the Kanangadu—beds resembled those from Tinnevelly and Ceylon. The author believes that the Palk

Bay is the motherland of the Mannar pearl oysters. In a second chapter the author discusses first of all the limitations of the pearl-oyster habitat in Palk Bay. A second biological note contains the results of the author's observations on the pearl oyster spat, and he distinguishes three stages of development of the pearl oyster larvæ and estimates that oyster larvæ may be subject to current disposal for as long a period as fifteen days. In a third biological note the author details the results of his investigation on the parasites found in the oysters of the Tondi beds.

BOOKS RECEIVED.

Alignment Charts: their Principle and Application to Engineering Formulæ. By E. S. Andrews. Pp. 32. (London: Published for J. Selwyn and Co. by Chapman and Hall, Ltd.) 1s. 3d. net.

The Health of the Child. By Dr. O. Hildesheim. Pp. xii+111. (London: Methuen and Co., Ltd.) 1s. net.

Nature and Science on the Pacific Coast. Pp. xii+302+plates. (San Francisco: Paul Elder and Co.) 1.50 dollars.

The Essentials of Agriculture. By H. J. Waters. Pp. x+455+xxxvi. (Boston and London: Ginn and Co.) 1.25 dollars.

A First Book of School Gardening. By A. Logan. Pp. vi+151. (London: Macmillan and Co., Ltd.) 1s. 6d.

Exercises in Laboratory Mathematics. By A. W. Lucy. Pp. 245. (Oxford: At the Clarendon Press.) 3s. 6d.

Arithmetic of Alternating Currents. By E. H. Crapper. Pp. vii+208. (London: Whittaker and Co.) 2s. 6d. net.

Alternating-Current Work. By W. P. Maycock. Pp. xxiv+415. (London: Whittaker and Co.) 6s. net.

Morals in Evolution. By Prof. L. T. Hobhouse. Pp. xvi+648. (London: Chapman and Hall, Ltd.) 10s. 6d. net.

Masonry. By Prof. M. A. Howe. Pp. ix+160. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6s. 6d. net.

Working Data for Irrigation Engineers. By E. A. Moritz. Pp. xiii+395. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 17s. net.

The Examination of Hydrocarbon Oils and of Saponifiable Fats and Waxes. By Prof. D. Holde. Translated by Dr. E. Mueller. Pp. xv+483. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21s. net.

Elementary Chemical Microscopy. By Prof. E. M. Chamot. Pp. xiii+410. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12s. 6d. net.

All About the Zeppelins and other Enemy Aircraft. By F. Walker. Pp. 32. (London: Kegan Paul and Co., Ltd.) 6d. net.

Railroad Field Manual for Civil Engineers. By Prof. W. G. Raymond. Pp. vii+386. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12s. 6d. net.

Overcrowding and Defective Housing in the Rural Districts. By Dr. H. B. Bashore. Pp. 92. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4s. 6d. net.

The Internal Combustion Engine. By H. E. Wimperis. New edition. Pp. xvi+319. (London: Constable and Co., Ltd.) 6s. 6d. net.

The Near-Eastern Problem and the Pan-German Peril. By V. Yovanovitch. Pp. 47. (London: Watts and Co.) 6d. net.

Russia and Democracy: the German Canker in Russia. By G. de Wesselitsky. Pp. viii+96. (London: W. Heinemann.) 1s. net.

Plane Trigonometry. By H. L. Reed. Pp. xiii+290+xvi. (London: G. Bell and Sons, Ltd.) 3s. 6d.

Elementary Studies in Plant Life. By Prof. F. E. Fritsch and Dr. E. J. Salisbury. Pp. xv+194. (London: G. Bell and Sons, Ltd.) 2s.

Statics. By R. C. Fawdry. Part ii. Pp. v+159-305+viii. (London: G. Bell and Sons, Ltd.) 2s.

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